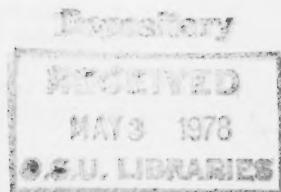


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ABSTRACTS



VOLUME 11, NUMBER 9
MAY 1, 1978

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CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center, Office of Water Research and Technology, U.S. Department of the Interior



VOLUME 11, NUMBER 9
MAY 1, 1978

W78-03701 -- W78-04200

The Secretary of the U.S. Department of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Depart-

ment. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1978.

SELECTED WATER RESOURCES

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

Selected journal monographs in formats related as well as re teristics, c Each abstract of descriptive **Resource** 10 fields search ca **Resource** Technolo **WRSIC IS** COPIES NAL. Suf readers to or other s **Selected** the scienti engineers of the Wa (WRSIC). Interior an Science a munity by research ordinating nical info and inves To provide active wa "centers

SELECTED WATER RESOURCES ABSTRACTS

FOREWORD

Select Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by co-ordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstract-

ing, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on the inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the Bio-Science Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center
Office of Water Research and Technology
U.S. Department of the Interior
Washington, DC 20240

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

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06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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09 MANPOWER, GRANTS, AND FACILITIES

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10 SCIENTIFIC AND TECHNICAL INFORMATION

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

DESIGN OF WATER RESOURCES PROJECTS WITH INADEQUATE DATA, VOLUME 2.
International Association of Scientific Hydrology, Gentbrugge (Belgium).
For primary bibliographic entry see Field 4A.
W78-03783

WATER RESOURCES PROJECTS IN NIGERIA AND THE HYDROLOGICAL DATA EMPLOYED IN THEIR PLANNING AND DEVELOPMENT,
Ifc Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W78-03784

APPLICATION OF COUTAGNE'S AND TURC FORMULAS TO THE SOUTHERN MOZAMBIQUE RIVERS,
For primary bibliographic entry see Field 4A.
W78-03789

RELATION OF HYDROLOGICAL PROGRAMS OF THE CENTER OF HYDROGRAPHIC STUDIES FOR COMPLETE STUDIES OF HYDRAULIC RESOURCES WITH INSUFFICIENT DATA, R. Heras.
In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 155-198, 1974.

Descriptors: *Water resources, *Computer programs, *Data processing, Hydrologic data, Programs, Hydrologic aspects, Model studies, Foreign countries, Reservoir operation, Systems analysis, *Spain, Inadequate data.

A list and description of 153 computer programs available for studying hydrological problems were given. Programming language was not given. Types of programs available varied from those that list data to programs capable of systems analysis of hydrological systems and hydrological model studies. (See also W78-03783) (Humphreys-ISWS)
W78-03791

OBJECTIVE CRITERIA TO DECLARE A SERIES OF DATA SUFFICIENT FOR TECHNICAL PURPOSES,

A. Penta, and F. Rossi.

In: Design of Water Resources Projects with Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 227-239, 1974. 4 fig, 10 ref.

Descriptors: *Statistical methods, *Hydrologic aspects, *Estimating, Mathematical models, Model studies, Probability, Equations, Analytical techniques, Hydrology, Inadequate data.

It was supposed: that for technical purposes it is necessary to estimate the values $x_{\text{sub}} \phi$; a hydrological variable x may assume with a given probability ϕ ; that x can be measured directly; and that its n values have been recorded. The series of the n values of x was defined sufficient if it consents to estimate $x_{\text{sub}} \phi$ with a reliability adequate for technical purposes. By referring to the usual statistical methodologies, the authors presented objective criteria to recognize whether the series of n values is sufficient. Diagrams were presented that indicate which minimum values of n are necessary for the series to be considered suffi-

cient. From the diagrams it is evident that for the same values of n in the series, sufficiency is strictly linked to the variability of x . (See also W78-03783) (Humphreys-ISWS)
W78-03795

SOME CRITERIA USED IN HYDROLOGIC STUDIES WITH INADEQUATE DATA, C. Q. Gois.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 241-252, 1974. 4 fig.

Descriptors: *Hydrology, *Africa, *Runoff, *Watersheds(Basins), Rainfall disposition, Water resources, Hydrologic aspects, Drainage, Foreign countries, Foreign research, Analytical techniques, *Angola(Africa), Inadequate data.

In territories where the hydrologic networks are still scarce, it is necessary to adopt simplified designing criteria which might lead to sufficiently reliable results. Some criteria normally utilized for hydrological studies of the general plans for the development of the water resources of rivers in semi-arid areas of Portuguese African territories were presented, and an example of their application to Okavango Basin in Angola was given. The obtained results are approximate, but they can be considered sufficiently safe for the purpose. And moreover, when decisions would be taken for the design of specific projects, further data will be available and then a more reliable analysis can be made. (See also W78-03783) (Humphreys-ISWS)
W78-03796

DETERMINATION OF HYDROLOGICAL CHARACTERISTICS IN POINTS WITHOUT DIRECT HYDROMETRIC DATA,
World Meteorological Organization, Bogota (Columbia); and United Nations Development Program, Bogota (Columbia).
For primary bibliographic entry see Field 4A.
W78-03797

NEW MODELS OF FREQUENCY LAW OF RUNOFF STARTING FROM PRECIPITATIONS,
I.T.O.P. Coll., Madrid (Spain).
For primary bibliographic entry see Field 4A.
W78-03798

ESTIMATION OF DESIGN FLOODS AND THE PROBLEM OF EQUATING THE PROBABILITY OF RAINFALL AND RUNOFF,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W78-03801

DESIGN DISCHARGE DERIVED FROM DESIGN RAINFALL,
Public Works Research Inst., Tokyo (Japan).
T. Kinoshita, and T. Hashimoto.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 557-562, 1974. 2 tab.

Descriptors: *Design criteria, *Discharge(Water), *Rainfall-runoff relationships, *Design flow, Rainfall disposition, Rainfall, Hyetographs, Model studies, Data processing, Runoff, Watersheds(Basins), Hydrology, Methodology, Foreign countries, Flood control, *Japan, Inadequate data.

A design discharge for flood control in Japan is in general derived from a design rainfall since discharge data are not sufficient for designing. The procedure of derivation and its merits and

demerits were explained according to the following four steps: (1) design rainfall in a certain return period is determined by a probability process; (2) design rainfall distributions are obtained by enlargement of rainfall distributions of recent representative storms; and (4) a design discharge is determined by the simulation model with enlarged rainfall distributions. The procedure is flexible, and improvement is expected with development of hydrology. (See also W78-03783) (Humphreys-ISWS)
W78-03807

METHODS FOR THE ESTIMATION OF MAXIMUM DISCHARGES OF SNOW MELT AND RAINFALL WATER WITH INADEQUATE OBSERVATIONAL DATA,
Gosudarstvennyi Gidrologicheski Inst., Leningrad (USSR).
For primary bibliographic entry see Field 2E.
W78-03811

A STUDY OF MAXIMUM FLOOD DISCHARGE FORMULAS,
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W78-03813

URBAN FLOOD WATER MANAGEMENT SYSTEMS IN SEMIARID REGIONS: MODEL EXTENSION, DESIGN AND APPLICATION,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 6A.
W78-03965

2B. Precipitation

NEW MODELS OF FREQUENCY LAW OF RUNOFF STARTING FROM PRECIPITATIONS,
I.T.O.P. Coll., Madrid (Spain).
For primary bibliographic entry see Field 4A.
W78-03798

2C. Snow, Ice, and Frost

SNOW MECHANICS SYMPOSIUM.
International Association of Scientific Hydrology, Gentbrugge (Belgium).
Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No 114, 1975. 452 p.

Descriptors: *Conferences, *Snow, *Ice, *Avalanches, Snowpacks, Physical properties, Mechanical properties, Stress, Deformation, Movement, Measurement, Snow cover, Melt water, Firn, On-site investigations, Surveys, Failure(Mechanics), Analytical techniques, Stress analysis, *Snow mechanics, Snow structure.

The purpose of the symposium was to focus attention on the basic physics and mechanics of deposited and moving snow. From the point of view of a fundamental scientific understanding, snow mechanics is difficult—much more difficult, for example, than ice mechanics. Snow comes in such a variety of forms that it is not at all easy to categorize it, and then not at all easy to reproduce physically the form that one has categorized. The subject areas covered included: (1) the physical fundamentals of the structure and texture of snow, the properties of ice, and the physical processes within the snowpack in relation to its mechanical properties. (2) The mechanical fundamentals of the relations between stress, deformation and history in snow, and failure criteria for snow. (3) The fluid mechanics of stress and deformation within

Field 2—WATER CYCLE

Group 2C—Snow, Ice, and Frost

the natural snow pack and rapid snow movements. (See W78c03999 thru W78-04035) (Humphreys-ISWS) W78-03998

MECHANICS AND STRUCTURE OF SNOW AS A DISPERSED SYSTEM, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

D. Kuroiwa.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 3-15, 1975. 8 fig, 2 tab, 15 ref.

Descriptors: *Snow, *Mechanical properties, *Laboratory tests, Ice, Analytical techniques, Analysis, Compaction, Density, Foreign research, Cohesion, Porosity, *Japan, Snow mechanics.

The most fundamental structural and intrinsic properties of snow were treated in relation to mechanical properties. Two structural factors for the compression of snow, a and b, were derived from Kawakita's equation similar to van der Waal's Equation. The factor a depends on geometrical shapes of snow crystals or ice grains, and b depends primarily on their intrinsic properties such as intergranular friction and cohesiveness. In relation to the structural factors, experimental studies on the cohesive force between ice grains were reviewed. It was pointed out that the structural discontinuities found in snow texture are related closely to the discontinuities found in the density dependence of mechanical properties of snow. The experimental studies of fluidization of snow were discussed, with special reference to the cohesive force and sintering between grains. (See also W78-03998) (Humphreys-ISWS) W78-03999

MASS TRANSFER AND METAMORPHISM IN SNOW COVER, Moscow State Univ. (USSR). Snow Avalanche Problem Lab.

K. F. Voitkovsky, V. N. Golubev, N. I. Lapteva, E. S. Troshkina, and L. A. Ushakova.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 16-24, 1975. 5 fig, 15 ref.

Descriptors: *Snow cover, *Crystal growth, *Ice, *Thermal properties, Thermal conductivity, Mass transfer, Crystals, Foreign research, Particle size, Temperature, Diffusion, Conduction, Analysis, Analytical techniques, On-site investigations, *USSR, Snow mechanics.

Continuous metamorphic processes due to mass transfer of material and to recrystallization growth of grains take place in snow cover. This metamorphism is associated closely with the thermal regime and strained state of the snow cover. Roles played by diffusion and conduction on thermal conductivities were discussed. It was shown experimentally that at temperatures near 0°C, these two components of the effective thermal conductivity of the snow cover have comparable values. The thickness of the quasiliquid film on the surface of ice crystals was determined by inert gas adsorption and nuclear magnetic resonance techniques in the temperature range of 0 to -8°C. Results obtained demonstrated that at equal temperature gradients the mass transfer due to water vapor diffusion is two orders of magnitude greater than that due to material migration through the quasiliquid film. Theoretical consideration was given to the grain recrystallization growth mechanism in snow cover. Calculations demonstrated that recrystallization growth rates due to crystal dimensions differences and those due to differences in relative strain of individual grains

differ by more than an order of magnitude. Results of field observations have shown that modification of some structural characteristics by metamorphic processes in snow cover is in good agreement with the values calculated by means of the recrystallization growth theory. (See also W78-03998) (Humphreys-ISWS) W78-04000

TIME-TEMPERATURE DEPENDENCE OF SINTERING IN PERENNIAL ISOTHERMAL SNOWPACKS, Cold Regions Research and Engineering Lab., Hanover, NH.

A. J. Gow.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 25-41, 1975. 13 fig, 3 tab, 37 ref.

Descriptors: *Snowpacks, *Crystal growth, *Ice, *Antarctic, On-site investigations, Crystallization, Snow, Isotherms, Thermal properties, Compressive strength, Growth rates, Crystals, Consolidation, Time, Age, Density, Particle size, Analytical techniques, Analysis, Data collections, Temperature, Aging(Physical), *Greenland, Sintering, Snow mechanics.

The time-temperature dependence of sintering in dry polar snowfields was investigated at several locations in Antarctica and Greenland. This study utilized samples from deep holes and shafts that actually penetrated the snow-ice transition at a number of sites, and demonstrated: (1) that density increases linearly with the logarithm of the age of the snow (sintering time), (2) that the mean crystal size of the snow increases linearly with age, and (3) that the unconfined compressive strength of the snow also increases linearly with age. The log time-linear densification of polar snow carries through to at least 96% theoretical density. The temperature dependence of densification is demonstrated clearly in the times needed to reach the snow-ice transition; less than 100 years is required at a constant in situ temperature of -15°C, whereas more than 5,000 years is needed to complete the transformation at -60°C. The data further indicated that transformation times increase logarithmically with decreasing snow temperatures. Data on crystal growth in dry isothermal snow demonstrated a strong linear relationship between the mean cross sectional areas of crystals and their ages. The rate of growth of crystals also shows a very strong dependence on temperature, the rate of growth in snow at -15°C being approximately 100 times faster than that at -60°C. Age-strengthening data from Camp Century indicated a value of 125-130 x 10 to the 5th power N/sq m for the ultimate unconfined compressive strength of bubble-free polycrystalline ice at -24°C. The important effect of bubbles was demonstrated in the fact that the unconfined compressive strength of ice containing 10% pore space (this would be equivalent to material at the snow-ice transition) is only about half that of bubble-free ice. Thin-section studies of the changes occurring in pore-crystal relationships during sintering showed that the snow-ice transformation is entirely analogous with the full-scale isothermal sintering of powder compacts. The two processes differ mainly in the rates of change which occur very much more slowly in a dry polar snowpack. Most of the difference can be attributed to the much larger sizes of grains in snow, such grains generally being two to three orders of magnitude larger than the particles in powder compacts. (See also W78-03998) (Humphreys-ISWS) W78-04000

STUDIES ON DEPTH HOAR, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

E. Akitaya.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 42-48, 1975. 4 fig, 4 ref.

Descriptors: *Crystal growth, *Snow, *Laboratory tests, Thermocline, Physical properties, Snow cover, Frost, Heat transfer, Thermal properties, Analytical techniques, Crystals, Particle size, Density, Temperature, Analysis, Foreign research, *Japan, Snow mechanics, Snow structure, *Depth hoar.

A series of experiments on growing depth hoar were carried out in a cold laboratory. Depth hoar crystals grew in snow when the snow was subjected to a consistent negative temperature gradient for a long period. Depth hoar crystals were classified into the two types: skeleton type and solid type. The solid-type depth hoar (comprising short-column and thick-plane grains) grew predominantly under temperature gradients smaller than about -0.25°C/cm, and the skeleton-type depth hoar grew in snow having a large air space under large temperature gradient. Hardness of depth hoar decreased, changed scarcely, or increased according to the magnitudes of temperature gradient and density of original snow. The occurrence of natural convection of air in snow subjected to negative temperature gradients was studied by using natural snow and artificially prepared snow samples and by measuring the heat flow. Natural convection of air occurred only in artificial samples with very large air spaces. (See also W78-03998) (Humphreys-ISWS) W78-04002

GRAIN AND BOND GROWTH IN WET SNOW, Cold Regions Research and Engineering Lab., Hanover, NH.

S. C. Colbeck.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 51-61, 1975. 6 fig, 11 ref.

ARMY 4A061102 B52E, Task Area 02.

Descriptors: *Snow, *Crystal growth, *Thermodynamic behavior, *Mathematical studies, Crystals, Physical properties, Theoretical analysis, Thermal properties, Particle size, Density, Melting, Thermocline, Temperature, Consolidation, Analytical techniques, Heat flow, Bonding, Snow mechanics, Wet snow, Snow structure.

Grain growth, bond growth and densification of wet snow are determined partly by the distribution of equilibrium temperature in the snow matrix. At high water saturations the equilibrium temperature decreases with grain size, causing small particles to melt and large particles to grow. Melting also occurs at intergrain contacts, causing low strength and rapid densification. At low saturations the capillary pressure controls temperatures, and particle size has a smaller effect. Grain growth proceeds slowly, although melting at the contacts does increase with overburden pressure. At low saturations the water 'tension' causes large attractive forces, and large bonding strengths occur. (See also W78-03998) (Humphreys-ISWS) W78-04003

ROLE OF THE LIQUID-LIKE LAYER IN SNOW METAMORPHISM, Moscow State Univ. (USSR). Snow Avalanche Problem Lab.

L. A. Ushakova, and E. S. Troshkina.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 62-65, 1975. 12 ref.

Descriptor solidification, thickness, melting, Snow me

Available demonstrating, thickness, 0°C, reaches exists on melting a layer is e means of Viscosity, coe nuclear efforts to by ob face are required also W78-04002

THE ROTATION PROBLEM, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science. G. Wakabayashi.

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Descriptor *Percolation, site, Permeability, site investigations, Foreign Analytical, Snow me

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WATER CYCLE—Field 2

Snow, Ice, and Frost—Group 2C

Descriptors: *Snow cover, *Crystals, *Ice, Consolidation, Diffusion, Physical properties, Melting, Foreign research, Foreign countries, *USSR, Snow mechanics, Sintering, Snow structure.

Available experimental and theoretical data demonstrate that a liquid-like layer, whose thickness increases when temperature approaches 0°C, reaching the value of the order of 0.000001 cm, exists on the surface of ice particles below the ice melting point. Mobility of water molecules in this layer is extremely high and determines the kinetics of sintering metamorphism because the specific surface area of the ice-air interface, measured by means of inert gas adsorption, is quite substantial. Viscosity of the liquid-like layer and surface diffusion coefficient were evaluated on the basis of experimentally obtained absorption line width of nuclear magnetic resonance. It was concluded that efforts to interpret snow metamorphism exclusively by observation of sintering of ice spheres or by observation of changes in the ice-air interface surface area cannot be successful. Further investigation is necessary to elucidate the nature of the ice surface, and, if particular, quantitative estimation is required of surface molecules mobility. (See also W78-03998) (Humphreys-ISWS) W78-04004

THE ROLE OF MELTWATER IN DENSIFICATION PROCESSES OF SNOW AND FIRN, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

G. Wakahama.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 66-72, 1975. 4 fig, 1 tab, 13 ref.

Descriptors: *Snow cover, *Melt water, *Firm, *Percolation, Melting, Ice, Laboratory tests, Density, Percolating water, Crystal growth, Flow, On-site investigations, On-site tests, Physical properties, Particle size, Consolidation, Crystals, Analytical techniques, Foreign research, *Japan, Snow mechanics, Wet snow, Snow structure.

It is well known that melt water can weaken the mechanical strength of snow and that the densification of snow may be accelerated by the existence of melt water within the snow. Experimental studies on the densification processes and the metamorphism of wet snow containing free water of 0-30% were made both in a snow field and in a cold laboratory. It was found that the rates of densification, density, and hardness of snow vary with the lapse of time as the function of free water content of snow. The percolation rate of melt water in a snow cover was also measured in connection with the free water content of snow.

Microscopic studies on the densification and metamorphism of wet snow were conducted, and 16 mm motion pictures were taken in an effort to clarify the mechanism of densification of snow. In the case of wet snow free from stress, snow grains turned into coarser rounded particles and ice bonds between the snow grains became smaller in number. This may result in the mechanical weakening of the snow. When wet snow was compressed, snow grains were brought closer as packing proceeded, whereby ice bonds between the snow grains grew thicker, until finally they turned into a coherent body of bubbly ice. This may be a predominant transformation process from firm to glacier ice in the accumulation area of a temperate glacier. (See also W78-03998) (Humphreys-ISWS) W78-04006

THE MECHANISM OF ROTTING OF ICE LAYERS WITHIN A STRUCTURED SNOW-PACK, National Inst. of Scientific Research, Quebec. E. J. Langham.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 73-81, 1975. 7 fig, 1 tab, 8 ref.

Descriptors: *Snowpacks, *Ice, *Permeability, *Melting, Thermal properties, Thermal conductivity, Snowmelt, Deterioration, Crystals, Radiation, Temperature, Absorption, Mechanical properties, Meteorology, Structure, Diffusion, Erosion, Theoretical analysis, Mathematical studies, Analytical techniques, Equations, Foreign research, Snow mechanics, Snowpack structure.

Ice layers that form on the surface of a snowpack become part of its structure when the layers are buried by subsequent snowfalls. The evolution of the ice layers plays a key role in determining both the mechanical properties and the permeability of the snow to water. The permeability controls the movement of water in the snowpack and is important in the release of wet avalanches and snowmelt floods. The processes which lead to the disintegration of ice layers are not responsible for the transfer of large amounts of energy. Rather, they function in the manner of a trigger mechanism which can operate when the snowpack has reached a critical temperature of about -0.1°C. Warming by thermal conduction produces an exponential approach to the ice point, which, under suitable conditions, may bring the snow to this threshold temperature during the course of a single day. When this happens, one of the trigger mechanisms, or a combination of them, can take over and cause the ice layer first to become permeable and later to disintegrate. A sharp drop in temperature following these events will restore the status quo, providing that air has not entered the ice layer. This means that an ice layer could become permeable for a brief period during a day which would produce corresponding surges in a runoff hydrograph. In the case of avalanches, there would be a time of day when the mechanical strength is least and the avalanche hazard is greatest. Various calculations were made with the purpose of showing the nature of the phenomenon of disintegration of ice layers. The lack of suitable data prevented a more detailed analysis, and more measurements are needed. In view of the consequences of the ideas proposed here, there is also a need to conduct some careful experiments to test their validity. (See also W78-03998) (Humphreys-ISWS) W78-04006

METAMORPHISM OF SNOW AND ICE SINTERING OBSERVED BY TIME LAPSE CINE-PHOTOMICROGRAPHY, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

D. Kuroiwa.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 82-88, 1975. 4 fig, 11 ref.

Descriptors: *Snow, *Crystallization, *Laboratory tests, Crystals, Ice, Photography, Microscopy, Temperature, Thermocline, Analytical techniques, Methodology, Melting, Freezing, Foreign research, Snow mechanics, Photomicrography.

Metamorphism of snow crystals and grains was observed under an alternating temperature gradient by using time lapse cine-photomicrography. Original forms of the snow crystals were destroyed by vapor transfer due to the alternating temperature gradient, but in high density snows, ice bondings between grains were accelerated by the vapor transfer. The following conspicuous phenomena were observed during the sintering processes: surface migrations of liquid-like layers, complicated movements of air bubbles in ice, and

change of crystallographic orientations of ice spheres. Ice spheres containing 0.01% KCl were used to investigate the effect of liquid phase, which exerts great influence on the sintering of ice. The activation energy for sintering was 30 kcal/mol for pure ice and 16 kcal/mol for KCl ice. (See also W78-03998) (Humphreys-ISWS) W78-04007

NUMERICAL PARAMETERS TO IDENTIFY SNOW STRUCTURE, Swiss Federal Inst. for Snow and Avalanche Research, Weissfluhjoch-Davos. W. Good.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 91-102, 1975. 4 fig, 3 tab, 15 ref.

Descriptors: *Snow, *Crystallography, *Physical properties, *Alpine, Sampling, Ice, Particle shape, Particle size, Instrumentation, Crystals, Laboratory tests, Equipment, Computers, Computer programs, Photogrammetry, Data processing, Model studies, Mathematical studies, Analytical techniques, Analysis, Numerical analysis, Foreign research, *Japan, *Greenland, Snow structure.

Thin sections of snow and ice samples were analyzed using an automatic scanning microscope in combination with a software package to perform subsequent data analysis. From the light intensities, software determines the homogeneous areas of the cut crystals and parameterizes these areas (pattern recognition). The technique of factorial analysis was used to find a geometrical interpretation of the 21 parameters calculated for each sample. Independent factors, formed as linear combinations of these parameters, span a vector space. In this space, 62% of the total content of information of the parameter set is represented in the plane of first two factors. Three axes account for 70% of the information. The first factor (49%) correlates negatively with the non-planar specific grain surface and positively with grain diameter, planar area, and mean radius of convex grain boundaries. Alpine and Greenland snow samples in different states of equitemperature metamorphism and ice from a desalination experiment were compared. Examples were given showing the difference between homogeneous and inhomogeneous snow samples as well as demonstrating the change of structure as a function of depth (time) for Greenland snow. (See also W78-03998) (Humphreys-ISWS) W78-04008

THE TEMPERATURE DEPENDENCE OF HARDNESS OF SNOW, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

K. Tsuruta.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 103-109, 1975. 6 fig, 4 ref.

Descriptors: *Snow, *Mechanical properties, *Laboratory tests, Temperature, Instrumentation, Equipment, Compaction, Young's modulus, Densitometry, Methodology, Analysis, Equations, Foreign research, *Japan, Snow structure, Hardness(Snow).

The temperature dependence of hardness of snow was investigated by the use of Kinosita's hardness gauge in a temperature range from 0 to -56°C. The value of hardness increased linearly with decreasing temperature down to -40°C. However, below -40°C the value of hardness did not change. In order to convert the values of hardness measured at various temperatures to the values of hardness at a specific temperature, -5°C, an empirical formula

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was proposed. The relation between the temperature dependence of hardness and density of snow also was discussed. (See also W78-03998) (Humphreys-ISWS) W78-04009

ON THE RAMMSONDE HARDNESS EQUATION, Swiss Federal Inst. for Snow and Avalanche Research, Weissfluhjoch-Davos.

H. U. Gubler.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 110-121, 1975. 11 fig, 2 ref.

Descriptors: *Snow, *Mechanical properties, *Testing procedures, Strength, Laboratory tests, Equipment, Analysis, Data collections, Instrumentation, Mathematical studies, Penetration, Foreign research, Equations, Tensile strength, Density, Analytical techniques, Sounding, *Switzerland, Hardness(Snow), Sonde, Rammsonde hardness, Snow mechanics.

A new Rammsonde equation was developed which better describes the real energy transfer from the sonde to the snow. The energy transfer was measured with the help of a built-in force transducer and a penetration length measurement device. The well-known simple Rammsonde equation can be improved easily to account for the energy losses. The correlation between ram hardness and tensile strength was measured and discussed. The Swiss Rammsonde has been used universally for many years to measure the displacement resistance to penetration of the layers of a snowpack. This instrument is suitable for snow hardness measurements from low to very high hardness, but it cannot be adapted for very low hardness snow. The hardness profile is measured from the highest layer down. The material displacing probe has the shape of a cone with a point angle of 60 deg. The experiments showed that the deformation mechanism responsible for the hardness depends strongly on the rate of deformation. The displacement-hardness changes one to two orders of magnitude as a function of penetration speed. Shaft, extensions, and hammerguide of the Rammsonde should be fixed together. This would improve the energy transfer by 30-60% and at the same time simplify the energy loss calculation. Also, the reproducibility of the ram tests would be better. For an improved understanding of the correlation between ram hardness and tensile strength, the dependence of the strength on the intergranular structure has to be investigated. A correlation without knowing further characteristics of the snow sample will not be possible. (See also W78-03998) (Humphreys-ISWS) W78-04010

DEUTERIUM AND OXYGEN-18 CONTENTS AS AN INDEX OF THE PROPERTIES OF SNOW COVERS,

Gesellschaft fuer Strahlen- und Umweltforschung
m.b.H., Neuherberg bei Munich (West Germany).
Inst. fuer Radiohydrodynamik.

H. Moser, and W. Stichler.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 122-135, 1975. 13 fig, 17 ref.

Descriptors: *Snow cover, *Properties, *On-site investigations, Snow, Laboratory tests, Oxygen, Deuterium, Oxygen isotopes, Crystallization, Chemical properties, Temperature, Profiles, Evaporation, Surveys, On-site data collections, Analysis, Distribution, Spatial distribution, Foreign research, Snow structure.

On the basis of the results of observation on natural snow covers supplemented by laboratory tests

in cold chambers, it was shown and explained in part how and whereby the original deuterium and oxygen-18 contents of snow undergo a change in the snow cover in the course of time. Variations in isotope content thus are produced among other factors by evaporation of the snow, by condensation of the air humidity into the snow cover, and by melt, sublimation, and recrystallization (metamorphism) phenomena. Since all of these effects occur in layers close to the surface, the isotope contents of the deeper strata of a snow profile remain unaltered. Also, a possible percolation of melt water through these layers is practically of no influence. A comparison of the variation of the deuterium content with that of the oxygen-18 content provided information on whether the changes in isotope content take place in a thermodynamical state of equilibrium of the phases involved. The still qualitative results from laboratory and field tests indicated that measurements of the stable isotope content are capable of providing information on origin and aging of a snow cover as well as insights into internal mass transport processes. (See also W78-03998) (Humphreys-ISWS) W78-04011

ON THE DIELECTRIC CONSTANT OF WET SNOW, Innsbruck Univ. (Austria). Physikalisches Inst. W. Ambach, and A. Denoth.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 136-142, 1975. 4 fig, 11 ref.

Descriptors: *Snow, *Electrical properties, *Mechanical properties, Mathematical models, Frequency, Measurements, Instrumentation, Melt water, Mixing, Analysis, Analytical techniques, Foreign research, *Dielectric constant, Snow structure, Wet snow, Fine grain snow, Coarse grain snow.

A study was reported on the dielectric constant of wet snow, yielding optimum conditions for the construction of an instrument for determining the free water content in the snow cover by dielectric measurements. The frequency dependence of the dielectric constant of fine-grained snow samples can be described by the Cole-Cole model (spectrum of different relaxation times), whereas that of coarse-grained snow samples satisfies the Debye model (one relaxation time only). From this, the conclusion may be drawn that the relation between the dielectric constant and the free water content depends on the snow structure when using frequencies of measurement of f less than 1 MHz. Already at frequencies of 20 MHz, the structural influences are negligibly small. Therefore, a twin T bridge was developed as an electronic measuring instrument for the frequency region of 20 MHz. For the evaluation, a generally valid nomograph was given. Furthermore, it was shown that the mixing formula by Polder and Van Santen which contains the depolarizing factor $g = (0.4912/0.4912/0.0176)$, very well reflects the dielectric constant of wet snow. G corresponds to inclusions having the shape of rotational ellipsoids with an axial ratio of 1:10.9 with the mixing formula referring to a statistic distribution of inclusions. A statistic distribution of ice discs in air was assumed as being the carrier medium (dry snow). (See also W78-03998) (Humphreys-ISWS) W78-04012

KAISER EFFECT IN SNOW, Montana State Univ., Bozeman. Dept. of Earth Sciences.

C. C. Bradley, and W. St. Lawrence.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 145-154, 1975. 5 fig, 3 ref.

Descriptors: *Snow, *Physical properties, *Prestressing, *Acoustics, Laboratory tests, Dead loads, Compressive strength, Loads(Forces), Tensile strength, Equipment, Testing procedures, Stress relieving, Laboratory equipment, Snow mechanics(Kaiser effect).

Acoustical signals emanating from stressed snow indicate that snow, in common with other crystalline materials, exhibits Kaiser effect or 'memory' of previous stress. This memory can be quite specific as to the magnitude of the prestress (compressive or tensile). These conclusions were drawn from laboratory experiments in which dimensioned snow columns were subjected to uniaxial dead loads, both in compression and in tension, and then stressed after relaxation periods. Experiments on the longevity of the memory function indicated that most of the decay takes place in the first 6 h, but that it is still detectable after relaxation periods of up to 24 h. (See also W78-03998) (Humphreys-ISWS) W78-04013

THE DEFORMATION OF SNOW IN TERMS OF A STRUCTURAL MECHANISM, Montana State Univ., Bozeman. Dept. of Earth Sciences.

W. St. Lawrence, and C. C. Bradley.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 155-170, 1975. 6 fig, 1 tab, 9 ref. NSF GA 3943, DA-ARO-D-31-124-71-G59.

Descriptors: *Snow, *Deformation, *Theoretical analysis, *Structural behavior, Physical properties, Analytical techniques, Laboratory tests, Analysis, Elastic deformation, Elasticity(Mechanical), Mathematical models, Mechanical properties, Strain, Stress analysis, Snow mechanics.

A one-dimensional theory was developed to describe the deformation of snow. This theory considers the deformation process in snow in terms of intergranular and intragranular deformations. These two components of deformations were considered further in terms of their elastic and inelastic components. As part of this development, the nature of acoustical emissions in snow was defined. This definition was applied then to include acoustical emission data in the constitutive law. A comparison between theoretical and experimental results showed good agreement. (See also W78-03998) (Humphreys-ISWS) W78-04014

CREEP-INDUCED CHANGES IN STRUCTURE AND DENSITY OF SNOW, Moscow State Univ. (USSR). Snow Avalanche Problem Lab.

K. F. Voitkovsky, A. N. Bozhinsky, V. N. Golubev, M. N. Laptev, and A. A. Zhigulsky.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 171-179, 1975. 6 fig, 3 ref.

Descriptors: *Snow, *Mechanical properties, *Structural behavior, *Creep, Ice, Density, Compaction, Compressibility, Elastic deformation, Plastic deformation, Physical properties, Laboratory tests, Laboratory equipment, Analysis, Analytical techniques, Equations, Acoustics, Data collections, Temperature, Foreign research, *USSR, Snow structure, Snow mechanics.

Creep of snow is directly related to changes in density and structure. As a result, the mechanical properties of snow undergo continuous changes. Experiments on uniaxial compression demonstrated that three stages of creep-induced structure changes can be singled out which correspond

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to three main stages of creep. These are also accompanied by appreciable changes of elastic wave propagation velocities in snow. Thus, it was found possible to utilize the method of ultrasonic wave propagation through snow samples to study structural changes. It was established experimentally that snow samples offer different resistance to compression and extension. In the uniaxial compression of snow, the creep rate is 1.4-2.0 times larger than that in the case of extension (at equal loads, other factors being identical). Compaction of snow also develops during creep at pure shear stresses. Observations of snow cover changes on mountain slopes and near obstacles in conjunction with laboratory studies provided new data for the evaluation of creep process effects on changes of density and structure of snow. A rheological model of snow was suggested. Further studies of laws governing deformation of snow require further information on the quantitative relation of creep and strength characteristics of structure, density and temperature. Additional information on these relations will make it possible to solve such problems as prediction of changes in mechanical properties and stability of snow cover on mountain slopes. (See also W78-03998) (Humphreys-ISWS) W78-04015

CONTINUUM MECHANICS: A POWERFUL TOOL IN SOLVING ICE AND SNOW PROBLEMS,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Div. of Mechanics.

H. Ziegler.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 185-195, 1975. 14 fig, 12 ref.

Descriptors: *Snow, *Ice, *Mathematical studies, *Theoretical analysis, Analytical techniques, Glaciers, Flow, Anisotropy, Elastic deformation, Shear stress, Mathematics, Equations, Analysis, Structural behavior, Stress analysis, Structural analysis, Movement, Foreign research, *Continuum mechanics, Snow mechanics.

The laws of continuum mechanics and of their applicability of practical problems were discussed. Continuum mechanics consists of two types of statements: laws that are generally valid (although they may be expressed in various forms) and relations characterizing (and, at the same time idealizing) special classes of bodies. The most outstanding property of the theory is that it can be carried through to a large extent on a general level, regardless of the properties of the body considered, and that the constitution of the body is introduced at the latest possible stage. In this way, the various branches as elasticity, plasticity, fluid mechanics, etc., are obtained as special cases of the same unified theory. In order to treat any problem in continuum mechanics in a serious and competent manner, a complete system of differential equations express the general laws of mechanics, possibly thermodynamics, and the particular properties of the material considered. The side conditions are boundary and possibly initial conditions. The examples discussed show how continuum mechanics can be used in solving practical problems. The approach is certainly more demanding than the heuristic methods still widely used in practice. However, it is the only correct approach. It is to be regretted that, in any single application, idealizing assumptions cannot be avoided. However, there is no doubt that a correct approach on a dubious basis is still better than a dubious approach of a dubious basis. (See also W78-03998) (Humphreys-ISWS) W78-04016

STRESS AND FRACTURE OF SNOW SLABS,

Department of the Environment, Calgary (Alberta). Glaciology Div.

R. I. Perla.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 208-221, 1975. 11 fig, 27 ref.

Descriptors: *Snow, *Rupturing, *Reviews, *Avalanches, Glaciology, Stability, Mechanical properties, Movement, Stratigraphy, On-site investigations, Mathematical studies, Stress, Shear, Slabs, Fracture(Mechanics), Analysis, Analytical techniques, Snow mechanics, Snow slabs.

Observations of slab fracture geometry were reviewed. The slab bed surface (main shear sliding surface) is essentially planar, and with few exceptions inclined between 30 deg and 50 deg. The crown surface (upslope tension fracture) is nearly perpendicular to the bed surface and tends to arc around between the flanks (side boundaries) which are often sawtoothed. The flank-to-flank dimension is typically 100 and sometimes 1,000 times the slab thickness. The Stauchwall (downslope shear boundary) is generally obliterated by the moving slab; however, it appears that the crown-to-Stauchwall dimension is usually less than the flank-to-flank dimension. Stratigraphic measurements taken above the crown fracture indicated that snow slabs are not restricted to narrow bands of density, temperature, or strength indices. Data show qualitatively that a slab is a relatively weak layer. Rapid fracture depends on the interaction between slab tension and bed surface shear. The dynamic jolt of an initial tension fracture overcomes the residual strength of the bed surface. Theoretical computations of tension stress were attempted. It was shown that snow parameters which associate with relatively low tensile stress in the neutral zone associate with relatively high tensile stress near the crown; this raises questions about the importance of tension change in the neutral zone as an explanation of slab instability. Instead critical tension may originate because of strain softening at the bed surface, or perhaps due to the collapse of a thick, weak layer beneath the bed surface. Field evidence seems to support the two-dimensional model of initial crown fracture, followed by bed surface fracture from crown-to-Stauchwall. A three-dimensional fracture model was proposed to explain observed fracture patterns, particularly the observed planes of intersection formed by bed and crown surfaces. (See also W78-03998) (Humphreys-ISWS) W78-04018

A CONSTITUTIVE EQUATION FOR CREEPING SNOW,

Swiss Federal Inst. for Snow and Avalanche Research, Weissfluhjoch-Davos.

B. Salm.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 222-235, 1975. 7 fig, 3 tab, 8 ref.

Descriptors: *Snow, *Rheology, *Creep, Theoretical analysis, Mathematical studies, Mechanical properties, Mathematics, Physical properties, Analysis, Deformation, Laboratory tests, Analytic techniques, Equations, Stress analysis, Stress, Snow mechanics, Snow structure.

On the basis of the principle of least irreversible force, a constitutive equation for creeping snow in a quasistationary state was established. As a consequence of this principle, the constitutive equation depends only on the dissipation function of the system. This function was developed in power series of the invariants of the stress tensor. Tests showed that because of the distinct non-newtonian behavior of snow, terms up to the sixth degree of the invariants have to be taken into account. (See also W78-03998) (Humphreys-ISWS) W78-04019

CREEP AND THE SNOW-EARTH INTERFACE CONDITION IN THE SEASONAL ALPINE SNOWPACK,

Washington Univ., Seattle.

D. M. McClung.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 236-248, 1975. 6 fig, 2 tab, 11 ref.

Descriptors: *Snow, *Creep, *Alpine, *Theoretical analysis, Glaciology, Mathematical models, Glaciers, Velocity, Avalanches, Snowpacks, Movement, Deformation, Physical properties, Analytical techniques, On-site tests, Mathematical studies, Poisson ratio, On-site data collections, Analysis, Shear, Stress, Topography, Interfaces, Snow mechanics, Snow sliding, Cascade mountains.

This paper was concerned with the two slow, viscous components of motion in the seasonal alpine snowpack, creep (internal deformation) and glide (slip of the entire snowpack over the ground). From field measurements in the Cascade Mountains, two nonlinear constitutive laws were deduced: (1) the relationship between the stress and deformation for well-settled, well-metamorphosed, isothermal snow, and (2) the relationship between the shear stress at the base of the snowpack and the glide velocity. In connection with the proposed glide constitutive law, a physical and mathematical theory of snow gliding was presented. In this theory, local creep around bed obstacles was defined as the important mechanism for glide. In the formalism presented, the stagnation depth was defined as the fundamental neutral zone measurement to characterize the topography or terrain roughness. Definition of the stagnation depth suggests a quantitative method of classifying topography of glide slopes as an alternative to the empirical glide factor utilized in the Swiss guidelines for avalanche defence construction. It is evident that a number of experiments would have to be performed to classify slope topography by stagnation depths. The advantage of such a classification would be that knowledge of the stagnation depth allows immediate formulation of the slip boundary condition from a quantitative physical and mathematical theory. (See also W78-03998) (Humphreys-ISWS) W78-04020

A REVIEW OF BASIC SNOW MECHANICS,

Cold Regions Research and Engineering Lab., Hanover, NH.

M. Mellor.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974: International Association of Hydrological Sciences Publication No. 114, p 251-291, 1975. 20 fig, 94 ref.

Descriptors: *Snow, Properties, *Reviews, *Mathematical models, Deformation, Rheology, *Physical properties, *Mechanical properties, Elastic deformation, Creep, Poisson ratio, Failure(Mechanics), Friction, Viscosity, Equations, Model studies, Youngs modulus, Seismic waves, Frequency, Kinetics, Dynamics, Movement, Stress analysis, Analytical techniques, Compressibility, Density, *Snow mechanics.

Narrowly defined, snow mechanics deals with forces and displacements in all forms of snow, i.e., with the kinematics, dynamics and energetics of snow in both condensed and dispersed states. More broadly defined, it also embraces the underlying physics of processes relevant to mechanical behaviour and the useful but disconnected empiricism associated with snow engineering, avalanche prediction, etc. In an introductory section, research goals were identified, a historical perspective of snow mechanics was outlined, and requirements for theoretical analysis, in the form

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of constitutive equations and failure criteria, were specified. A section of deformation reviewed idealized rheology for nondestructive loading, giving general differential equations and pertinent special solutions for one-dimensional models. Simple elastic properties, as derived from quasistatic and dynamic tests on snow, were summarized, and effects of rate, frequency, density, temperature, etc., were considered. Viscoelastic properties were described in terms of complex moduli, viscosity for creep transients, loss factor, etc., and independent variables such as temperature, density and frequency were taken into a consideration. A section of failure started with discussion of failure, strength, and failure criteria, especially as the terms apply to snow. Strength measurements in uniaxial tension and compression were considered, and available data were compiled. Correlation of strength and elastic modulus was explored as a possible method for estimating strength from nondestructive *in situ* tests. A section of boundary friction introduced the physical theory relating to kinetic friction of coherent snow surfaces and summarized experimental findings that give variations of kinetic friction with contact pressure, dimensions of contact areas, sliding speed, ambient temperature, and slider materials. (See also W78-03998) (Humphreys-ISWS) W78-04021

CONTINUOUS MEASUREMENTS OF DEFORMATIONS ON AN AVALANCHE SLOPE, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

R. A. Sommerfeld.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 293-297, 1975. 5 fig, 11 ref.

Descriptors: *Snow, *Deformation, *Colorado, *On-site investigations, Measurement, Movement, On-site tests, Instrumentation, Monitoring, Equipment, Creep, Methodology, Gages, Avalanches, Testing procedures, Snow mechanics, Snow slabs, Slope-parallel gages, Vertical gages, Creep-angle gages.

Deformation measurements are necessary in order to test various methods of calculating stresses in snow slabs. Ideally, these measurements should be continuous and made with minimum disturbance to the snow slab. Instruments which can be embedded in the slab, and continuously monitor the positions of points in the slab without disturbance were described. They were used to monitor the deformations in the Roll avalanche at Berthoud Pass, Colorado, during the winters of 1972-1973. These experiments produced what was, in effect, thousands of deformation experiments on a large mass of snow whose properties are slowly changing. As such, the full potential measurements will not be realized until they are used in conjunction with stress analyses. One reason for presenting this paper was to show that the measurements exist and can be made available in various forms. (See also W78-03998) (Humphreys-ISWS) W78-04022

A FIELD EXPERIMENT ON THE RATE OF DENSIFICATION OF NATURAL SNOW LAYERS UNDER LOW STRESSES, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

K. Kojima.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 298-308, 1975. 8 fig, 1 tab, 9 ref.

Descriptors: *Snow, *Mechanical properties, *On-site tests, Density, Stress, Strain, Measurement, On-site investigations, Methodology, Test-

ing procedure, Analysis, Analytical techniques, Compressibility, Foreign research, Snow mechanics.

The main purpose of this paper was to determine the relation between the strain rate of densification and the compressive stress of snow. The field experiment reported was concerned with snow of low densities from 0.1 to 0.3 g/cm³ under low stresses less than 15 g/sq cm. It was found that the strain rate of snow layer was proportional to a load, but the coefficient of proportionality decreased exponentially as the density of snow increased. Considerable increase was observed in the density of a thin layer of snow, above which the overlying snow had been completely removed. It was concluded that the densification of the layer was caused by the compressive stress due to its own weight rather than to the metamorphic change of its structure. (See also W78-03998) (Humphreys-ISWS) W78-04023

INTERNAL STRAINS AND STRESSES OF SNOW COVER ON SLOPES, Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.

H. Shimizu, and T. Huzioka.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 321-331, 1975. 9 fig, 1 tab, 7 ref.

Descriptors: *Snow, *Mechanical properties, *Stress, *On-site investigations, Deformation, Snow cover, Strain, On-site tests, Measurement, Foreign research, Testing procedures, Methodology, Equipment, Mathematical models, Analytical techniques, Data collections, Foreign countries, Instrumentation, *Japan, Snow mechanics, Principal stress.

Internal strains of snow cover on slopes were observed directly by use of a newly designed marking system at the avalanche observatory, Toikanbetsu, northern Hokkaido, Japan. Fine straight holes, 2 m in length and 18 mm in diameter, were bored in the snow cover on slopes in parallel to the contour line of the slope. A special boring instrument was used. From deformation of configuration of a set of holes in a unit layer of a snow cover, internal strains of the snow layer were calculated. The strain and stress conditions of a natural snow cover on a slope at Toikanbetsu were calculated. Directions of the principal stresses in a snow cover were given by the theory of finite homogeneous strain and stress. Simple formulas giving the magnitudes of the principal stresses in a unit layer of snow cover on a slope were derived, considering the condition of equilibrium of snow column along the principal axes of stresses, on the assumption that a proper homogeneous strain takes place in an individual unit layer of the snow cover. From field observations, the following were confirmed: (1) Directions and magnitudes of the principal stresses and strains varied considerably from place to place in the snow cover, and from time to time throughout winter. (2) A strong effect of Poisson's ratio of snow on the relation between the stress and strain was observed: occasionally extension was observed along the major principal axis of stress even by compressive stress, if the major principal stress was a much smaller compressive stress than the minor principal stress. (3) An extraordinarily big principal stress appeared when the direction of the principal axis of stress was nearly parallel to the slope. (See also W78-03998) (Humphreys-ISWS) W78-04025

STRESS ANALYSIS AND FAILURE PREDICTION IN AVALANCHE SNOWPACKS, Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.

F. W. Smith, and J. O. Curtis.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 332-340, 1975. 3 fig, 2 tab, 11 ref.

Descriptors: *Snowpacks, *Stress analysis, *Failure(Mechanics), *Colorado, Avalanches, Analytical techniques, Finite element analysis, Snow, Stress, Strain, Mechanical properties, On-site investigations, Theoretical analysis, Model studies, *Berthoud Pass(Colo), Snow mechanics, Analysis.

Results of finite element stress analyses of a five-layered avalanche snowpack which was observed at Berthoud Pass, Colorado, were given. An attempt was made to model the effects of a weak sublayer in the snowpack by prescribing nonlinear stress-strain behavior for a snow layer near the snow-ground interface. It was observed that under certain conditions, large tensile stresses oriented parallel to the slope may be produced in the upper layers of the snowpack, near the fracture line. The analyses support the hypothesis that avalanche release occurs by a shear failure in one of the lower layers. (See also W78-03998) (Humphreys-ISWS) W78-04026

STRAIN AND STRESS IN SNOW, FIRM AND ICE ALONG THE EGIG PROFILE OF THE GREENLAND ICE SHEET, Eidgenossische Technische Hochschule, Zurich (Switzerland).

R. Haefeli, and H. von Sury.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 342-352, 1975. 9 fig, 1 tab, 10 ref.

Descriptors: *Glaciology, *Ice, *Snow, *On-site investigations, Firm, Stress, Strain, Mechanical properties, Profiles, Surveys, Deformation, Density, Movement, Measurement, Velocity, On-site data collections, Foreign countries, *Greenland, Ice sheet, Hardness(Snow), Principal stresses.

The profile chosen for glaciological measurements by the EGIG (Expedition Glaciologique Internationale au Groenland) crosses the Greenland ice sheet from west to east between latitudes of 69 deg and 73 deg. Glaciological and geodetic measurements were made in 1959-1960 and 1967-1968. The ram profiles showed considerable differences between the two measurements, especially for the eastern slope of the ice sheet, which suggest climatic changes. At the principal stations of the EGIG profile, deformation polygons were established and measured at different times: squares of 1 km and pentagons of 15 km diameter. From these measurements, strain rates and principal stresses of the firm surface and the ice base, respectively, were deduced. Assuming a planar state of stress, the first principal stress in the ice yields approximately 1 bar (tension) and points in the direction of the EGIG profile. About 70 poles which mark the EGIG profile throughout the entire length of 900 km were surveyed in 1959 and 1967. The displacement vectors showed that the ice is flowing partially in the direction of the profile, but that it contains a northward component. The projections of these vectors on the direction of the EGIG profile showed a good agreement with the values obtained from balance equation of a two-dimensional ice sheet. The same is true for the strain rates along the profile. The strain rates deduced from the deformation polygons, together with the accumulation, were used to calculate the height variation of the ice sheet. The results were compared with the direct measurement of height variation by the survey. (See also W78-03998) (Humphreys-ISWS) W78-04027

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Snow, Ice, and Frost—Group 2C

MECHANICS OF SNOW AVALANCHES, Moscow State Univ. (USSR). Inst. Mekhaniki. S. S. Grigorian.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 354-368, 1975. 25 ref.

Descriptors: *Snow, *Avalanches, *Reviews, *Glaciology, Snow cover, Snowpacks, Forecasting, Movement, Rheology, Mechanical properties, Physics, Physical properties, Mathematical models, Friction, Model studies, Creep, Theoretical analysis, Foreign research, Foreign countries, *USSR, Snow mechanics, Air waves.

The main problems of snow avalanches are those of predicting: (1) avalanches, (2) avalanche motion, (3) the action of an avalanche upon obstacles, (4) the air wave, (5) the slow moving snow cover and its interaction with protective constructions, and (6) the problem of artificial release of avalanches. This paper surveyed the modern state of scientific knowledge about the nature of physical and mechanical processes connected with these problems, the level of progress in solving them, and the foreseeable prospects. The survey was based mainly on the results of scientists (mechanicians, mathematicians, and geographers) of Moscow University. (See also W78-03998) (Humphreys-ISWS) W78-04028

SIMULATION OF THE DYNAMICS OF POWDER AVALANCHES, Grenoble-I Univ. (France). Inst. de Mecanique. J. C. Tochon-Danguy, and E. J. Hopfinger.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 369-380, 1975. 6 fig, 13 ref.

Descriptors: *Model studies, *Avalanches, *Snow, *Laboratory tests, Dynamics, Hydraulic similitude, Hydraulic models, Density currents, Snow cover, Mathematical models, Mathematical studies, Theoretical analysis, Analytical techniques, Testing procedures, Velocity, Measurement, Entrainment, Foreign research, Dynamics, *France, Snow mechanics, Powder avalanches.

Powder avalanches are the most spectacular and most intriguing types of avalanches, but perhaps they are also the most accessible for laboratory studies. An adequate simulation is achieved if the boundary conditions, the densimetric Froude number, and the density ratio (δ rho)/rho sub 0, are maintained in the model. As for the Reynolds number, it is sufficient that it is high enough for direct viscous effects to become negligible. A salt solution gravity current respects all the similarity requirements except the density ratio. Experiments on such currents on a sloping bottom were carried out. The head growth and the front velocity as a function of downstream distance were measured for different slopes and inflow rates or volume supplies of heavy fluid. Some results on the velocity distribution in and around the head were obtained by the hydrogen bubble technique. A simple theoretical analysis showed how laboratory results can be applied and how the density parameter affects the flow. (See also W78-03998) (Humphreys-ISWS) W78-04029

SNOW CONTROL BY MODEL TECHNIQUES, Guelph Univ. (Ontario). School of Engineering. F. H. Theakston.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 382-390, 1975. 7 fig.

Descriptors: *Snowpacks, Control, *Canada, *Model studies, *Laboratory equipment, Snow, Laboratory tests, Testing procedures, Avalanches, Hydraulic models, Analytical techniques, Methodology, Open channels, Flow, Open channel flow, Hydraulic similitude, Airports, Buildings, Highways, Railroads, Cities, Foreign research, *Snow simulator, Snow mechanics, *Snow control.

Snow can now be controlled by remedial solutions determined from a laboratory procedure known as a 'snow simulator'. It is an open channel water flume wherein the water represents the wind currents and silica sand represents snow. Models are placed in the flume and deposition of simulated snow occurs as the sand and water move through the flume in exactly the same manner as that in a prototype situation. Both qualitative and quantitative analyses are made of snow depths and remedial devices are installed to improve unsatisfactory conditions. It is a fast, certain and economical method of determining the best method of snow and wind control. Airports, highways, townsites, buildings, railways, and more recently avalanches have all been studied successfully by this method. (See also W78-03998) (Humphreys-ISWS) W78-04030

MULTIVARIATE DATA ANALYSIS AS A TOOL FOR DAY-BY-DAY AVALANCHE FORECAST, Grenoble Univ. (France). Lab. de Mecanique des Fluides.

P. Bois, C. Obled, and W. Good.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 391-403, 1975. 8 fig, 4 tab, 10 ref.

Descriptors: *Avalanches, *Forecasting, *Statistical methods, *Snowpacks, Analysis, Analytical techniques, Data processing, Regression analysis, Sampling, Mathematical studies, Model studies, Snow management, Decision making, Foreign research, Discriminate analysis, Wet snow avalanches, Dry snow avalanches.

Operationally, the quantitative prediction of avalanche occurrence is possible at present only with statistical methods. Among those available, discriminant analysis was used in a two-step procedure. Variables distinguishing well between subgroups (days with dry snow avalanches, days with wet snow avalanches and days without avalanches) were selected by factorial analysis, and given days were classified then into one of the subgroups on an operational basis. Periods of simulated and effective test runs showed that this method is able to give valuable avalanche forecast. The most serious problems arise due to uncertainty of which day, during bad weather, an avalanche occurs and due to the possibility that all physically important variables may not be measured. (See also W78-03998) (Humphreys-ISWS) W78-04031

EFFECT OF GLIDE AND CREEP ON RIGID OBSTACLES, Washington Univ., Seattle.

C. B. Brown, and R. J. Evans.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 407-414, 1975. 4 fig, 7 ref, 1 append.

Descriptors: *Snow, *Creep, *Loads(Forces), *Barriers, Snowpacks, Movement, Finite element analysis, Velocity, Mechanical properties, Kinetics, Analytical techniques, Analysis, Mathematical studies, Snow mechanics, Glide velocity.

The forces on a rigid obstacle caused by creep and glide of snow down a slope were provided by a finite element procedure. The element is a trapezium, with sides bounded by the snow surface, the snow-ground interface, and planes normal to the ground. The problem was treated as one of plane strain, but extensions to considerations of three dimensions were discussed. Glide resistance was incorporated as a basal shear dependent on the glide velocity; the snow pack was treated as having a linear nonhomogeneous flow law. In conclusion, it was noted that the force calculated is in reasonable agreement with that predicted by the Swiss guidelines for comparable glide and creep factors. (See also W78-03998) (Humphreys-ISWS) W78-04032

ON THE EXTENSION OF HAEFELI'S ONE-DIMENSIONAL THEORY OF STRESS DISTRIBUTION WITHIN A SLOPING SNOW COVER,

National Research Center for Disaster Prevention, Niigata (Japan). Inst. of Snow and Ice Studies. M. Shoda.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 415-424, 1975. 2 fig, 7 ref.

Descriptors: *Creep, *Stress analysis, *Snow cover, Model studies, Theoretical analysis, Velocity, Distribution patterns, Mechanical properties, Avalanches, Mathematical studies, Mathematical models, Analysis, Foreign research, Analytical techniques, Equations, Profiles, Snow mechanics.

The author generalized Haefeli's approximate solutions for one-dimensional distribution of creep velocity and stresses in a monolayer snow cover lying on a uniform slope of finite length by starting from the equilibrium equation of stresses and a few assumptions for simplifications. In order to estimate the high stress concentration at a thin viscous layer lying between layers of fine snow with more thicknesses and far lower viscosities than those of the sandwiched thin layer, the monolayer theory must be extended to multilayer theory. Such thin layers are one of the typical sliding surfaces of huge slab avalanches. Applying the method for a monolayer to a sloping snow cover composed of double layers having respectively different thicknesses and mechanical properties, the author showed a systematic way to derive the one-dimensional solutions for two types of creep profiles, i.e., linear and parabolic. This method will apply to multilayer snow cover, and probably similar forms of the solutions will be obtained. (See also W78-03998) (Humphreys-ISWS) W78-04033

FRICITION COEFFICIENTS AND SPEED OF FLOWING AVALANCHES,

National Research Council of Canada, Ottawa (Ontario). Div. of Building Research.

P. A. Schaefer.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 425-432, 1975. 2 fig, 2 tab, 9 ref.

Descriptors: *Avalanches, *Snow, *On-site investigations, *Canada, Friction, Kinetics, Movement, Velocity, Density, Theoretical analysis, Foreign research, Foreign countries, On-site tests, British Columbia, *Rogers Pass(British Columbia), Snow mechanics.

Observations were made of the speed of avalanches by timing the advance of their front over a section of track covered with deep snow. The track under observation had uniform incline and cross section, and the avalanches could be as-

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Group 2C—Snow, Ice, and Frost

sumed to have constant mass and a uniform flowing motion. The observed speeds u could best be expressed by $sq u = 1420R(\sin \alpha - f \cos \alpha)$, with R the hydraulic radius and α the inclination of the track. The coefficient of kinetic friction f was found to be dependent primarily on the speed. Tables were presented for estimating the depth and density of the flowing snow from observations of the avalanche snow after it comes to rest. (See also W78-03998) (Humphreys-ISWS) W78-04034

SNOW AVALANCHE IMPACT PRESSURE ON AN OBSTACLE, Novosibirsk Railway Engineers Inst. (USSR)

E. P. Isaenko.

In: Snow Mechanics Symposium; Proceedings of the Grindelwald Symposium, Grindelwald, Bernese Oberland (Switzerland), April 1974; International Association of Hydrological Sciences Publication No. 114, p 433-440, 1975. 5 fig, 4 ref.

Descriptors: *Snow, *Avalanches, *Laboratory tests, *Stress analysis, Barriers, Loads(Forces), Deformation, Model studies, Testing procedures, Laboratory equipment, Stress, Strain, Measurement, Velocity, Movement, Analysis, Foreign research, Analytical techniques, Theoretical analysis, Mechanical properties, Density, Mathematical studies, Youngs modulus, *USSR, Snow mechanics.

Since 1968 the Novosibirsk Railway Engineers Institute has been carrying out research on the snow avalanche impact pressure on an obstacle. The volumetric and stress state of a snow mass were studied by means of a special pendulum impact testing machine. Both normal and radial stresses in the snow samples placed in steel cylinders and their axial deformation under the impact conditions were recorded on the oscillograph tape. A system of equations combining the tensor components of strain and stress in the snow samples under shock loads was derived. Modelling criteria for simulation of slab avalanche impact were determined. The experimental investigations of slab avalanche impact were carried out in two channels. Snow blocks had following dimensions: 1.4-1.7 m in width, 1.2-1.4 m in height and 1.5-6 m in length. The density of snow samples varied from 200 to 470 kg/cu m. The velocities of snow blocks movement reached 36 m/s. Sixty-four recordings of the impact process when the obstacle plane was normal to the sample movement direction, and 24 recordings when the obstacle plane was at an angle to the snow block movement were obtained. The theoretical analysis of the process of the plastic bar impact on the perfectly rigid obstacle and analysis of the experimental results showed that snow strains during the avalanche impact should be taken into account if its velocity is more than 15-20 m/s. The neglect of these strains overstates the computed values of impact forces of avalanches. (See also W78-03998) (Humphreys-ISWS) W78-04035

2D. Evaporation and Transpiration

DRIP IRRIGATION OF SUGARCANE MEASURED BY HYDRAULIC LYSIMETERS, KUNIA, OAHU, Hawaii Univ., Honolulu. Water Resources Research Center. For primary bibliographic entry see Field 3F. W78-03753

METHODOLOGY EXISTING FOR ESTIMATING FREE SURFACE WATER EVAPORATION, F. C. Granado.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 59-75, 1974. 5 ref.

Descriptors: *Evaporation, *Water loss, *Equations, *Reviews, Reservoirs, Estimating, Methodology, Measurement, Instrumentation, Evaporimeters, Free surfaces.

The purpose of this paper was to recount the methodology for estimating free surface water evaporation, particularly in the case of a reservoir, when studying the regulation curves thereof or the regulation-exploitation system, for statistics and empirical methods. Sixteen equations for calculating evaporation were presented and discussed in varying detail. (See also W78-03783) (Humphreys-ISWS) W78-03786

DETERMINATION OF EVAPORATION IN CASE OF THE ABSENCE OR INADEQUACY OF DATA, Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).

P. P. Kuzmin, and A. P. Vershinin.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 217-225, 1974. 1 tab, 19 ref.

Descriptors: *Evaporation, *Estimating, *Equations, Water loss, Water balance, Evapotranspiration, Water surfaces, Land, Surfaces, Foreign countries, Foreign research, Soil moisture, *USSR, *Inadequate data.

The determination of evaporation under natural conditions is of great importance for the estimation of the present and future water resources, for water resources management, and for the solution of various theoretical problems in the field of hydrology and meteorology. The existing computation methods were subdivided into three groups. The first group comprised the methods based on the physical analysis of the evaporation process. The second group included methods based on physical principles combined with semi-empirical constants which can be determined with the help of accurate measurements of actual evaporation in representative regions. The third group included methods based on the statistical analysis using only empirical relations, where empirical constants and coefficients are highly variable and depend on meteorological conditions. Practical recommendation and equations for the determination of evaporation by means of standard observational data from hydrometeorological stations were given. (See also W78-03783) (Humphreys-ISWS) W78-03794

SOIL MOISTURE OF THE RIDGY-TAKYR COMPLEX IN CENTRAL KARA KUM, (IN RUSSIAN), Desert Inst., Ashkhabad (USSR). For primary bibliographic entry see Field 2G. W78-04037

LAKE AND PAN EVAPORATION VALUES FOR NORTHERN ARIZONA, Northern Arizona Univ., Flagstaff. School of Forestry.

C. C. Avery.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 820, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, November 1977. 80 p. OWRT A-062-ARIZ(1), 14-34-0001-7005 and -7006.

Descriptors: Northern Arizona, Evaporation, *Evaporation pans, *Lake evaporation, *Lake Mary(Ariz), Lakes, *Evaporation losses, *Seepage losses, *Municipal water supply.

The objectives were to investigate and report on some site-specific water resources problems in northern Arizona. Specifically, the project has (1)

contributed to the development of a hydrologic and economic analysis of the feasibility of lining Upper Lake Mary, (2) searched out and analyzed historic records of pan evaporation for Northern Arizona, (3) maintained a Class A evaporation station at Lake Mary, Coconino County, Arizona for three summers, (4) mapped the surface configuration and bottom relief of Ashurst Lake, Coconino County, Arizona, and, for this lake, determined the depth-area-volume relationships, (5) made a preliminary assessment of the water balance of Ashurst Lake, and (6) provided some basic geologic data for Upper Lake Mary.

W78-04101

2E. Streamflow and Runoff

THE ECOLOGY OF A HIGH MOUNTAIN STREAM IN THE PYRENEES: I. PHYSICAL CONDITIONS, (IN FRENCH), Toulouse-3 Univ. (France). Lab. d'Hydrobiologie. P. Lavandier.

Ann Limnol. 10(2), p 173-220, 1974.

Descriptors: *Ecology, High mountain streams, *Pyrenees(France), Snow, Streams, *Estaragne, Temperature, Geographical conditions, Insolation.

The physical conditions in a high mountain stream (in France), the Estaragne and its tributaries, were analyzed in relation to the general geographical conditions. The snow cover over the streams lasts 4-7 mo. according to altitude. Flow rates are constant and low under the snow in winter, high during the thaw (with some current velocities up to 2.5 m/s), and show sudden variations after the snow melts. During floods, the discharge reflects the nature and force of disturbance as well as the capacities for retention in the catchment area. Temperatures are close to zero in winter. They rise with the melting of the snow and consequently fluctuate daily, with insolation having the greatest influence on these changes. Temperature and thermal amplitude increase from source to mouth, but are continuously influenced by the addition of cold water. Over 3 yr. the mean weekly temperatures attained maximum values of 4.2C at 2350 m and 9.9C at 1850 m altitude with thermal amplitudes of 1.5C and 6C respectively. Although the annual number of degree-days at the mouth is twice that near the source, it does not generally exceed 1000. The smallest tributaries are the earliest to be free of snow cover, they flood less frequently and are warmer than the main stream.—Copyright 1975, Biological Abstracts, Inc.

W78-03732

EFFECTS OF URBANIZATION ON FLOOD CHARACTERISTICS IN NASHVILLE-DAVIDSON COUNTY, TENNESSEE, Geological Survey, Nashville, TN. Water Resources Div.

For primary bibliographic entry see Field 4C. W78-03766

AN EXAMPLE OF REGIONAL CO-OPERATION FOR IMPROVING THE HYDROLOGICAL AND METEOROLOGICAL INFORMATION, World Meteorological Organization, Managua (Nicaragua). Central American Hydrometeorological Project.

For primary bibliographic entry see Field 7A. W78-03785

METHODS OF ANALYSING DEFICIENT DISCHARGE DATA IN ARID AND SEMI-ARID ZONES FOR THE DESIGN OF SURFACE WATER UTILIZATION, Tahal Water Planning for Asrael Ltd., Tel Aviv. For primary bibliographic entry see Field 4A. W78-03788

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MAPAI HYDROLOGICAL STUDY (LIMPOPO'S RIVER),
For primary bibliographic entry see Field 4A.
W78-03790

CALCULATION OF RUNOFF IN IRAQ,
For primary bibliographic entry see Field 4A.
W78-03793

ESTIMATION OF FLOODS BY MEANS OF THEIR SILT LOADS,
For primary bibliographic entry see Field 4A.
W78-03800

ESTIMATION OF DESIGN FLOODS AND THE PROBLEM OF EQUATING THE PROBABILITY OF RAINFALL AND RUNOFF,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W78-03801

SYNTHETIC UNIT HYDROGRAPH TECHNIQUE FOR THE DESIGN OF FLOOD ALLEVIATION WORKS IN URBAN AREAS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W78-03802

A DIMENSIONLESS UNITGRAPH FOR HONG KONG,
Southampton Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W78-03803

STUDY OF MAXIMUM FLOODS IN SMALL BASINS OF TORRENTIAL TYPE,
For primary bibliographic entry see Field 4A.
W78-03804

FLOOD ESTIMATION BY DETERMINATION OF REGIONAL PARAMETERS FROM LIMITED DATA,
For primary bibliographic entry see Field 4A.
W78-03805

PRACTICES OF DESIGN FLOOD FREQUENCY FOR SMALL WATERSHEDS IN THAILAND,
Royal Irrigation Dept., Bangkok (Thailand). Hydrology Div.
For primary bibliographic entry see Field 4A.
W78-03806

DESIGN DISCHARGE DERIVED FROM DESIGN RAINFALL,
Public Works Research Inst., Tokyo (Japan).
For primary bibliographic entry see Field 2A.
W78-03807

THE USE OF CENSORED DATA IN ESTIMATING T-YEAR FLOODS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W78-03808

ASSESSMENT OF DESIGN FLOODS IN BRAZIL,
For primary bibliographic entry see Field 4A.
W78-03809

METHODS FOR THE ESTIMATION OF MAXIMUM DISCHARGES OF SNOW MELT AND RAINFALL WATER WITH INADEQUATE OBSERVATIONAL DATA,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).

A. A. Sokolov.

In: Design of Water Resources Projects with Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 615-623, 1974. 32 ref.

Descriptors: *Floods, *Rainfall-runoff relationships, *Reviews, Discharge(Water), Methodology, Equations, Rational formula, Hydrographs, Runoff, Melt water, *Snowmelt, Rainfall, Watersheds(Basins), Precipitation(Atmospheric), Foreign countries, *USSR, Inadequate data.

The problem of flood computation was accepted by the UNESCO Co-ordinating council for the IHD as one of the most important problems. For its solution, the Working Group on Floods and their computation was established, and several projects on the IHD program essential for future research on floods and development and improvement of methods for floods computation have been realized. This paper gave an evaluation of the up-to-date state of the problem as means for its solution. Flood discharge computation schemes reviewed included: (1) Empirical or semi-empirical formula for discharge computation based on the account of some of its most important factors (e.g., drainage area or maximum precipitation rate), providing maximum water discharge only; and (2) Methods considering flood genesis and providing the possibility of plotting the whole hydrograph on the basis of time inflow of snowmelt and rainfall water and its transformation into runoff as a result of losses by infiltration, surface retention, lag along the slopes, and channel network. (See also W78-03783) (Humphreys-ISWS) W78-03811

COMPUTATION OF PROBABILISTIC VALUES OF LOW FLOW FOR UNGAUGED RIVERS,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 4A.
W78-03812

A STUDY OF MAXIMUM FLOOD DISCHARGE FORMULAS,
Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W78-03813

2F. Groundwater

RECHARGE AND NITROGEN TRANSPORT MODELS FOR NASSAU AND SUFFOLK COUNTIES, N.Y.,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W78-03756

DIGITAL MODEL OF THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
D. T. Hoxic.
Open-file report 77-676, August 1977. 54 p., 20 fig., 3 tab, 12 ref.

Descriptors: *Computer models, *Surface-groundwater relationships, *Hydrogeology, *Aquifer characteristics, *Wyoming, Groundwater movement, Groundwater availability, Irrigation, Industrial water, Projections, Hydrologic budget, *Arikaree aquifer(Wyo), Southeastern Wyoming.

A digital model that mathematically simulates the flow of ground water, approximating the flow system as two-dimensional, has been applied to

predict the long-term effects of irrigation and proposed industrial pumping from the unconfined Arikaree aquifer in a 400 square-mile area in southeastern Wyoming. Three cases that represent projected maximum, mean, and minimum combined irrigation and industrial ground-water withdrawals at annual rates of 16,176, 11,168, and 6,749 acre-feet, respectively, were considered. Water-level declines of more than 5 feet over areas of 124, 120, and 98 square miles and depletions in streamflow of 14.4, 8.9, and 7.2 cfs from the Laramie and North Laramie Rivers were predicted to occur at the end of a 40-year simulation period for these maximum, mean, and minimum withdrawal rates, respectively. A tenfold increase in the vertical hydraulic conductivity that was assumed for the streambeds results in smaller predicted drawdowns near the Laramie and North Laramie Rivers and a 36 percent increase in the predicted depletion in streamflow for the North Laramie River. (Woodard-USGS) W78-03761

GROUND-WATER LEVELS IN WYOMING, 1976,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03768

CHANGES IN AQUIFER-SYSTEM PROPERTIES WITH GROUND-WATER DEPLETION,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-03769

DEFINING REACTIONS AND MASS TRANSFER IN PART OF THE FLORIDAN AQUIFER,
Geological Survey, Reston, VA. Water Resources Div.
L. N. Plummer.
Water Resources Research, Vol. 13, No. 5, p 801-812, October 1977. 4 fig, 6 tab, 37 ref.

Descriptors: *Groundwater movement, *Mass transfer, *Radioactive dating, *Florida, *Aquifers, Analytical techniques, Age, Time, Chemical properties, Flow rates, *Floridan aquifer, Carbon-13, Carbon-14.

Use of mass balance relationships, mass transfer simulation procedures, and prediction of carbon isotopic composition of waters leads to the following conclusions regarding reactions occurring down the gradient in a portion of the Floridan aquifer: (1) The waters of the recharge area near Polk City have an average age of 3200 yr and have formed by congruent solution of dolomite and calcite. CO₂ entering the saturated zone in the vicinity of Polk City has a mean C-13 composition of -22.5 plus or minus 0.6 percent. (2) Down the hydraulic gradient from the vicinity of Polk City, isotopically light dolomites (C-13 = -3.9 to -1.5 percent) and gypsum dissolve. All reactions south of Polk City are incongruent to low-magnesian calcites. The reaction path between Polk City and Fort Meade is partially open to CO₂ presumably soil zone CO₂. Farther south down the gradient, between Fort Meade and Wauchula, the Floridan aquifer becomes essentially closed to CO₂. Farther south, between Wauchula and Arcadia, oxidation of lignite (possibly via sulfate reduction) adds additional carbon to the water composition. C-14 ages, corrected for the derived mass transfer reactions, are slightly younger than was previously recognized owing to consideration of incongruent dissolution. At the farthest point down the gradient, the age of (Arcadia) water is estimated to be 36,000 yr B.P. (3) Flow velocities derived from C-14 ages are in reasonable agreement with flow velocities estimated from hydrologic considerations and are approximately 2-10 m/yr. (4) The derived mass transfer reactions point to a complex

Field 2—WATER CYCLE

Group 2F—Groundwater

diagenetic history in central Florida. The position of the freshwater-seawater interface appears to determine whether dolomite will be a product of reactant mineral. Today, isotopically light diagenetic dolomites, which presumably formed when mixing zone stood at a higher stratigraphic level in central Florida, are reactants in the freshwater of the Floridan aquifer. (Woodard-USGS) W78-03770

GROUND-WATER RESOURCES OF CENTRAL AND SOUTHERN YORK COUNTY, PENNSYLVANIA.
Geological Survey, Harrisburg, PA. Water Resources Div.
O. B. Lloyd, Jr., and D. J. Growitz.
Pennsylvania Geological Survey, Harrisburg, Fourth Series, Water Resources Report 42, 1977. 93 p, 8 fig, 2 plates, 18 tab, 27 ref.

Descriptors: *Groundwater resources, *Aquifer characteristics, *Water yield, *Water quality, *Pennsylvania, Water wells, Well data, Hydrogeology, Pumping, Specific capacity, Maps, Water analysis, Chemical analysis, *York County(Pa).

The area of investigation is in the Conestoga Valley and Piedmont Uplands sections of the Piedmont province in Pennsylvania. From the specific capacities of wells in the bedrock aquifers it is estimated that 25 percent of the wells should produce 400 gpm, from the Ledger Formation; 140 gpm from the Conestoga Formation; about 50 to 100 gpm from the Chickies and Vintage Formations, the albite-chlorite schist and metavolcanics of the Wissahickon Formation, the Peters Creek Schist, and the shale of the Kinzers Formation; and less than 25 gpm from the Antietam and Harpers Formations, the Marburg Schist, and limestones of the Kinzers Formation. In general the water in the carbonate-rock aquifers has a hardness of about 220 mg/liter, and a pH of 7.0. Water in the noncarbonates has a hardness of about 50 mg/liter and pH of 5.9. The occurrence of nitrate is common in water from the albite-chlorite schist and metavolcanics of the Wissahickon Formation, Marburg Schist, Peach Bottom Slate, and Peters Creek Schist. Nitrate concentrations that exceed 45 mg/liter were found in water sampled from the Conestoga and Harpers Formations; the Marburg Schist and the albite-chlorite schist and metavolcanics of the Wissahickon Formation; and the limestones of the Kinzers Formation. (Woodard-USGS) W78-03771

WATER RESOURCES OF OKALOOSA COUNTY AND ADJACENT AREAS, FLORIDA.
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-03774

PRELIMINARY EVALUATION OF GROUND WATER IN THE PRE-PENNSYLVANIAN CARBONATE ROCKS, MCCOY AREA, COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-03776

GEOHYDROLOGICAL STUDIES IN SMALL AREAS WITHOUT SYSTEMATIC DATA.
For primary bibliographic entry see Field 4B.
W78-03778

PROSPECTS FOR GEOTHERMAL ENERGY APPLICATIONS AND UTILIZATION IN CANADA.
Toronto Univ. (Ontario). Inst. for Aerospace Studies.
For primary bibliographic entry see Field 4B.

W78-03845

SUITABILITY OF FLUOROCARBONS AS TRACERS IN GROUND WATER RESOURCES EVALUATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 5A.
W78-03967

STUDIES OF SUBTERRANEAN WATERS: 25. METHODS OF COLLECTING INTERSTITIAL SUBTERRANEAN WATERS, (IN FRENCH),
Centre National de la Recherche Scientifique, Moulis (France). Lab. Souterrain.
For primary bibliographic entry see Field 7B.
W78-04024

GROUNDWATER ANALYSIS BY TRITIUM TECHNIQUE: A PRELIMINARY EVALUATION,
Guam Univ., Agana. Water Resources Research Center.

J. F. Mink, and L. S. Lau.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 806, Price codes: A03 in paper copy, A01 in microfiche. Publication No. 2, October 1977. 29 p, 4 fig, 3 tab, 5 ref, 2 append. OWRT A-002-GUAM(1), 14-34-0001-6054, 7023, 7024.

Descriptors: *Groundwater, *Radioactive dating, *Tritium, Water sampling, Water analysis, Analytical techniques, Pollutant identification, Water quality, Water yield, *Guam.

Water samples representing basal, parabasal, basal spring, and perched water in limestone in northern Guam and volcanic groundwater in southern Guam were collected, analyzed, evaluated, and interpreted in terms of tritium and selected geochemical water quality parameters in 1976. The groundwater age was very young, about 5 or less years old, and readily rechargeable by contemporary rain water. There was a discernible gradation in the tritium level and chemical quality of the water samples. The study findings agree well with and augment current groundwater hydrologic knowledge and suggest prospects for possible additional water yield for several locations. W78-04100

2G. Water In Soils

CHEMICAL STABILIZATION OF SOFT SOILS,
Port and Harbour Research Inst., Kanagawa (Japan). Soil Stabilization Lab.
For primary bibliographic entry see Field 5G.
W78-03744

DRIP IRRIGATION OF SUGARCANE MEASURED BY HYDRAULIC LYSIMETERS,
KUNIA, OAHU, Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3F.
W78-03753

A STUDY ON THE ENVIRONMENTAL FACTORS IN AN EEL POND: III. LOW REDOX POTENTIAL OF THE POND SOIL IN MARCH 1972, (IN JAPANESE),
Freshwater Fisheries Research Lab., Tokyo (Japan).
Y. Satomi, J. Toi, and T. Ito.
Bull Freshwater Fish Res Lab Tokyo. 23(1), p 1-4, 1973.

Descriptors: Bronchonephritis, *Eel ponds, Environmental factors, Ponds, *Redox potential, *Soils, Salts, *Pond soil.

In recent years salt has been used in eel ponds to prolong the life span of eels affected by bronchonephritis. Salt has had a good effect of reducing the loss of eels by bronchonephritis but has increased the salt content of the pond in general. The effect of salt on pond soil was studied in eel ponds of Shizuoka Prefecture, Japan in March 1972. The study revealed the extremely low redox potentials and increased pH values of the pond soil. This had no relationship to the levels of organic substances of the pond. It was presumed that the Ca ions of the soil were replaced by Na ions of water, deteriorating the physical properties of the soil. (See also W76-12275 and W74-02933) Copyright 1975, Biological Abstracts, Inc. W78-03960

SOIL MOISTURE OF THE RIDGY-TAKYR COMPLEX IN CENTRAL KARA KUM, (IN RUSSIAN),
Desert Inst., Ashkhabad (USSR).
M. Nurbardiev.
Probl Osvoseniya Pustyn'. 1, p 70-73, 1974.

Descriptors: *Soil moisture, *Evaporation, Sands, Fedoseev's method, Humidity, *Central Kara Kum(USSR), Ridgy Takyr Complex(USSR), Soils.

The evaluation of evaporation rates depending on the relief forms was accomplished in accordance with Fedoseev's methods. A plot in a level sand area was taken as the standard, the humidity rate of the plot was accepted as 1. The humidity coefficient of the soil layer 0-50 cm in eastern and western slopes of sand ridge is 0.7 (as compared with the standard one), and in the takyr low areas 1.9. Copyright 1975, Biological Abstracts, Inc. W78-04037

2H. Lakes

DISCHARGE AND WATER-QUALITY DATA FOR SELECTED STREAMS AT LOW FLOW INCLUDING SOME BOTTOM-MATERIAL ANALYSES, AND LIMNOLOGICAL STUDY OF SIX LAKES, WESTCHESTER COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.

For primary bibliographic entry see Field 5B.
W78-03758

PHYSICAL, CHEMICAL, AND BIOLOGICAL RELATIONS OF FOUR PONDS IN THE HIDDEN WATER CREEK STRIP-MINE AREA, POWDER RIVER BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W78-03763

PHYTOPLANKTON AND ENVIRONMENTAL FACTORS IN LAKE HJALMAREN, 1966-1973,
National Swedish Environment Protection Board, Uppsala. Limnological Survey.
For primary bibliographic entry see Field 5C.
W78-03816

LIMNOLOGICAL STUDIES IN A LARGE, DEEP, OLIGOTROPHIC LAKE (LAKE OHRID, YUGOSLAVIA): SEASONAL AND ANNUAL PRIMARY PRODUCTION DYNAMICS OF THE PELAGIC PHYTOPLANKTON,
Hidrobioloski Zavod, Ochrida (Yugoslavia). For primary bibliographic entry see Field 5C.
W78-03820

S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO THE NEW YORK STATE WATER RESOURCES,
Calspan Corp., Buffalo, NY.

For print
W78-03962

ALGAL LIMIT IFYGL, URBAN TRIBUT Texas U For print
W78-03963

MICHIGAN UPPER Michigan For print
W78-03964

CHLOROTIONS ERIE, Michigan For print
W78-03965

ACTIN NORTHE LAKES IN E WATE Michigan Lansing For print
W78-03966

ATMOS SOUTH 1975, Michigan Research For print
W78-03967

BACTERI BOTTON PONDS SIAN), Ukraine Kiev (For print
W78-03968

FLORA BODIP (ENDE Polish perim For print
W78-03969

LIMNO OLIGOS GOSL RADIC GIAL Dartmouth cal Sci For print
W78-03970

DISSO WATE LAR ECOL Dartmouth cal Sci For print
W78-03971

WATER CYCLE—Field 2

Lakes—Group 2H

For primary bibliographic entry see Field 5A.
W78-03822

ALGAL NUTRIENT AVAILABILITY AND
LIMITATION IN LAKE ONTARIO DURING
IFYGL, PART I. AVAILABLE PHOSPHORUS IN
URBAN RUNOFF AND LAKE ONTARIO
TRIBUTARY WATERS,
Texas Univ. at Dallas, Richardson.

For primary bibliographic entry see Field 5C.
W78-03824

MICHIGAN TRIBUTARY LOADINGS TO THE
UPPER GREAT LAKES,
Michigan Dept. of Natural Resources, Lansing.
For primary bibliographic entry see Field 5B.
W78-03825

CHLORIDE AND NITROGEN CONCENTRA-
TIONS ALONG THE WEST SHORE OF LAKE
ERIE,
Michigan State Univ., East Lansing. Dept. of
Fisheries and Wildlife.
For primary bibliographic entry see Field 5B.
W78-03826

ACTINOMYCETE DISTRIBUTION IN
NORTHERN GREEN BAY AND THE GREAT
LAKES, TASTE AND ODOR RELATIONSHIPS
IN EUTROPHICATION OF NEARSHORE
WATERS AND EMBAYMENTS,
Michigan Dept. of Natural Resources, East
Lansing.
For primary bibliographic entry see Field 5C.
W78-03827

ATMOSPHERIC INPUT OF PHOSPHORUS TO
SOUTHERN LAKE HURON, APRIL-OCTOBER,
1975,
Michigan Univ., Ann Arbor. Great Lakes
Research Div.
For primary bibliographic entry see Field 5B.
W78-03828

BACTERIAL COENOSES OF WATER AND
BOTTOM SEDIMENTS OF THE FISHERY
PONDS IN THE UKRAINIAN SSR, (IN RUSSIAN),
Ukrainian Research Inst. of the Fish Industry,
Kiev (USSR).
For primary bibliographic entry see Field 5C.
W78-03829

FLORA AND FAUNA IN FRESHWATER
BODIES OF THE THALA HILLS OASIS
(ENDERBY LAND, EASTERN ANTARCTICA),
Polish Academy of Sciences, Warsaw. Inst. of Ex-
perimental Biology.
For primary bibliographic entry see Field 5C.
W78-03830

LIMNOLOGICAL STUDIES IN A LARGE, DEEP
OLIGOTROPHIC LAKE (LAKE OHRID, YU-
GOSLAVIA). A SUMMARY OF NUTRITIONAL
RADIOBIOASSAY RESPONSES OF THE PELA-
GIAL PHYTOPLANKTON,
Dartmouth Coll., Hanover, NH. Dept. of Biologi-
cal Sciences.
For primary bibliographic entry see Field 5C.
W78-03832

DISSOLVED ORGANIC MATTER IN LAKE-
WATER: CHARACTERISTICS OF MOLECUL-
AR WEIGHT SIZE-FRACTIONS AND
ECOLOGICAL IMPLICATIONS,
Dartmouth Coll., Hanover, NH. Dept. of Biologi-
cal Sciences.
For primary bibliographic entry see Field 5C.
W78-03833

RECENT SEDIMENTATION AND RESUSPEN-
SION OF ORGANIC MATTER IN EUTROPHIC
LAKE ESRØM, DENMARK,
Copenhagen Univ. (Denmark). Freshwater Biolog-
ical Lab.

For primary bibliographic entry see Field 5C.
W78-03834

THE PROFUNDAL BENTHIC ENVIRONMENT
OF TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 5C.
W78-03838

AGING AND EVALUATION OF TWIN LAKES
SEDIMENTS,
Colorado Cooperative Fishery Unit, Fort Collins.
For primary bibliographic entry see Field 2J.
W78-03839

BACTERIOLOGICAL SURVEY OF TWIN
LAKES, COLORADO,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 5C.
W78-03840

IFYGL TEMPERATURE TRANSECTS: TEM-
PERATURE DISTRIBUTIONS ACROSS THREE
SECTIONS OF LAKE ONTARIO CONTINU-
OUSLY TRANSVERSED OVER FOUR-DAY IN-
TERVALS IN JULY, AUGUST, AND OCTOBER
1972,
Canada Centre for Inland Waters, Burlington
(Ontario).

F. M. Boyce, and C. H. Mortimer.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB-264 003,
Price codes: A06 in paper copy, A01 in microfiche.
Working Draft of Final Report, 1976. 362 p., 114
fig., 8 tab., 13 ref., append. NOAA-2-35307 and
NOAA-3-35468.

Descriptors: *Lake Ontario, *Water temperature,
*Baseline studies, *Data collections, Depth,
Research equipment, IFYGL, Great Lakes, Circu-
lation, Monitoring, Equipment, Methodology,
Lakes, Water quality, Seasonal.

Three cross-sections of Lake Ontario were
scanned for temperature distributions by depth,
using towed depth-undulating instruments,
thermistor chains, and bathythermographs
deployed or towed from research vessels as part of
the IFYGL program. Cross-sections and dates of
continuous scanning during 1972 were (1) Olcott to
Oshawa (10-14 July, 9-12 August, 2-6 October); (2)

Bradlock Point to Presque Isle (24-28 July, 7-11

August, 2-6 October); and (3) Oswego to Prince
Edward Island (same as section 2). For section 1,
two measuring systems were used; one was an un-
undulating towed body, the 'Batfish,' carrying an
electronic bathythermograph (EBT) probe; the

second was a towed thermistor chain. In section 2,
a newly-developed undulating tempera-
ture/pressure sensor (described in an appendix)

was towed. For section 3, mechanical thermogra-
phs were used. Each monitoring system is

described in detail. Scanning results are presented in
126 transect diagrams showing depth, tempera-
ture, and date. These data are also compared with

all available contemporary data from recording instru-
ments moored in or near the transects, and

from Coastal Chain surveys made for other pur-
poses at the inshore ends of each transect. The

data constitute a data base for the study of up-
welling/downwelling events, quasi-geostrophic

flow, and internal waves. (Lynch-Wisconsin)
W78-03841

LAKES AND PONDS,
Pennsylvania Univ., Philadelphia. Dept. of Land-
scape Architecture.
For primary bibliographic entry see Field 6B.
W78-03842

CONCENTRATION OF TOTAL THIAMINE IN
ORGANS AND TISSUES OF FISHES FROM
THE KREMENCHUG RESERVOIR, (IN RUSSIAN),
Akademiya Nauk URSR, Kiev. Inst.
Hidrobiologii.
For primary bibliographic entry see Field 5C.
W78-03862

FLOW AND MAIN ELEMENTS OF BALANCE
OF BIOGENIC SUBSTANCES AND MAIN IONS
IN THE KIEV RESERVOIR, (IN RUSSIAN),
Akademiya Nauk USRS, Kiev. Inst.
Hidrobiologii.
For primary bibliographic entry see Field 5C.
W78-03878

METHODOLOGICAL CONSIDERATIONS IN
WESTERN LAKE SUPERIOR WATER-SEDI-
MENT EXCHANGE STUDIES OF SOME TRACE
ELEMENTS,
National Water Quality Lab., Duluth, MN.
For primary bibliographic entry see Field 5A.
W78-03985

LAGUNA DE BAY WATER RESOURCES
DEVELOPMENT,
Bureau of Experts, Sogreah, Grenoble, France.
For primary bibliographic entry see Field 5G.
W78-03994

GROWTH, DEVELOPMENT AND PRODUC-
TION OF THE MAIN CLADOCERAN SPECIES
OF LAKE SARTLAN, (IN RUSSIAN),
D. P. Pomerantseva.
Gidrobiol Zh. 10(6), p 66-70, 1974.

Descriptors: *Lake Sartlan(USSR), Growth rates,
Productivity, Biomass, Water temperature,
Ceriodaphnia reticulata, *Cladoceran, Cydrus
sphaericus, Daphnia longispina, Diaphanosoma
brachyurum, Lakes, Moina rectirostris, Russian
SFSR.

Data are presented on the linear growth, duration
and development in relation to water temperature,
production (P), biomass (B) and P/B ratios of
cladocera (Ceriodaphnia reticulata,
Diaphanosoma brachyurum, Cydrus sphaericus,
Daphnia longispina and Moina rectirostris) in
Lake Sartlan, a large fishery lake located in the
forest-steppe zone of western Siberia (Russian
SFSR, USSR). Copyright 1975, Biological Ab-
stracts, Inc.
W78-04038

HEAVY METAL CONCENTRATIONS IN ON-
TARIO FISH,
Toronto Univ. (Ontario). Inst. for Environmental
Studies.
For primary bibliographic entry see Field 5C.
W78-04039

BIOGEOGRAPHIC ANALYSIS OF ROTIFERS,
CLADOCERANS AND COPEPODS OF ALPINE
LAKES OF PAMIR AND TIEN SHAN, (IN RUSSIAN),
Tashkent Univ. (USSR).
V. F. Gurvich.
Gidrobiol Zh. 10(6), p 25-31, 1974.

Descriptors: *Biogeographic analysis, *Alpine
lakes, Crustaceans, *Cladocerans, *Copepods,
Lakes, *Pamir(USSR), *Rotifers, *Tien
Shan(USSR).

A comparative analysis of Rotatoria, Cladocera
and Copepoda was performed in Lakes Pamir and
Tien Shan (USSR), where 108 spp. of these 3
groups were found: 49 spp. of rotifers, 42 spp. of
cladocerans and 17 spp. of copepods. In Pamir 34,
35 and 14 spp. were found and in Tien Shan 30, 20

Field 2—WATER CYCLE

Group 2H—Lakes

and 9 spp., respectively. There were 15 spp. of rotifers, 13 spp. of cladocerans and 6 spp. of copepods common to both regions. The similarities and differences of the fauna of both high-mountain regions are explained by the geography and geological history. Copyright 1975, Biological Abstracts, Inc.

W78-04040

ROLE OF MICROORGANISMS OF THE DIGESTIVE TRACT IN THE NUTRITION OF POND FISH: 13. QUANTITY AND SPECIES COMPOSITION OF DIGESTIVE TRACT MICROORGANISMS OF CARP DURING ARTIFICIAL FEEDING, (IN RUSSIAN),

Akademija Nauk Litovskoi SSR, Vilnius. Inst. Zoologii i Parazitologii.

V. N. Lubanskene, K. K. Yankovichus, O. P. Tryapsheva, and L. A. Rachvunas.

Liet TSR Mokslo Akad Darb Ser C Biol Moksmai 1, p 65-70, 1976.

Descriptors: *Fish diets, *Carp, Fish, *Microorganisms, Nutrition, Ponds, Pseudomonas denitrificans.

Carp living on artificial food had less microorganism diversity and more physiological biochemical activity than fish living on natural food. Pseudomonas denitrificans, notable for high activity in synthesis of physiologically active substances, was strikingly predominant in the intestine of carps living on artificial food. The amount of microorganisms in carp intestine was directly dependent on the age and feeding intensity of the fish. The most microorganisms and the greatest species diversity were found in the fore- and Mid-intestine. Copyright 1977, Biological Abstracts, Inc.

W78-04051

MICROBIOLOGICAL CHARACTERISTICS OF LAKES IN THE YAROSLAVL OBLAST, (IN RUSSIAN),

For primary bibliographic entry see Field 5C.

W78-04058

RECLAMATION OF POLLUTED FARM PONDS,

Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 5G.

W78-04098

LAKE AND PAN EVAPORATION VALUES FOR NORTHERN ARIZONA,

Northern Arizona Univ., Flagstaff. School of Forestry.

For primary bibliographic entry see Field 2D.

W78-04101

ASSESSMENT OF WATER QUALITY STATUS AND TRENDS IN MINNESOTA BY REMOTE SENSING TECHNIQUES,

Minnesota Univ., Minneapolis.

For primary bibliographic entry see Field 5A.

W78-04105

GREAT LAKES WATERS: RADIATION DOSE COMMITMENTS, POTENTIAL HEALTH EFFECTS, AND COST-BENEFIT CONSIDERATIONS,

Argonne National Lab., IL.

For primary bibliographic entry see Field 5G.

W78-04109

ENVIRONMENTAL CONDITIONS OF PERCID WATERS IN CENTRAL EUROPE,

Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.

For primary bibliographic entry see Field 5C.

W78-04121

LIMNOLOGICAL CHARACTERISTICS OF ONTARIO LAKES IN RELATION TO ASSOCIATIONS OF WALLEYE (STIZOSTEDION VITREUM VITREUM), NORTHERN PIKE (ESOX LUCIUS), LAKE TROUT (SALVELINUS NAMAYCUSH), AND SMALLMOUTH BASS (MICROPTERUS DOLOMIEU),

Canada Centre for Inland Waters, Burlington (Ontario); and Fisheries and Marine Service, Ottawa (Ontario). Great Lakes Biogeography.

For primary bibliographic entry see Field 5C.

W78-04122

FACTORS AFFECTING THE SHIFT IN PREDOMINANCE FROM EURASIAN PERCH (PERCA FLUVIATILIS) TO ROACH (RUTILUS RUTILUS) IN THE KLIKAVA RESERVOIR, CZECHOSLOVAKIA,

Karlova Univ. Prag (Czechoslovakia). Dept. of Systematic Zoology.

K. Pivnicka and M. Svatora.

Journal of the Fisheries Research Board of Canada, Vol. 34, 1977, Part of the Proceedings of the Percid International Symposium convened at Quetico Centre, Ontario, September 24-October 5, 1976. p 1571-1575, 5 tab, 14 ref.

Descriptors: Environmental effects, *Limnology, Fish, Populations, Biological communities, Dominant organisms, Reservoirs, Fecundity, Reproduction, Czechoslovakia, *Perches, *Roach, Perca fluviatilis, Rutilus rutilus, Percids, Percidae.

Investigations into the factors considered responsible for the shift in predominance from Eurasian perch to roach was conducted ten years after the filling of the reservoir. It was concluded that the shift in predominance was primarily due to the decline in ratio of female to male perch spawners. The ratio was 1:4 for perch and unity for roach. Growth rate for roach in response to increasing abundance was greater than for perch. Under the same environmental conditions, the roach is theoretically capable of producing a more abundant population. (Chilton-ORNL)

W78-04123

TEMPERATURE REQUIREMENTS OF SOME PERCIDS AND ADAPTATIONS TO THE SEASONAL TEMPERATURE CYCLE,

Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.

K. E. F. Hokanson.

Journal of the Fisheries Research Board of Canada, Vol. 34, 1977, Part of the Proceedings of the Percid International Symposium convened at Quetico Centre, Ontario, September 24-October 5, 1976. p 1524-1550, 9 fig, 5 tab, 169 ref.

Descriptors: *Environmental effects, *Temperature, *Seasonal, Fish, Limnology, Adaptation, Review, Walleye, *Perches, Sauger, Management, Bibliographies, *Percids, Percidae.

Temperature requirements for some percids and cohabitat species are reviewed. Reflecting the intermediate temperature niche of percids in fish communities, percids are classified as temperate mesotherm. The present paper describes responses to temperature for each species in the areas of reproduction, growth, survival, and activity. It was concluded the percid life phases are uniquely adapted to the seasonal temperature cycle of a temperate climate. Implications for management are discussed. (Chilton-ORNL)

W78-04124

RESULTS OF AN EXPERIMENTAL FISHERY ON THE CRAYFISH ORCONECTES VIRILIS,

Michigan Dept. of Natural Resources, Lewiston. Hunt Creek Fisheries Research Station.

W. T. Momot, and H. Gowin.

Journal of the Fisheries Research Board of Canada, Vol. 34, 1977, p 2056-2066, 3 fig, 7 tab, 16 ref. NSF Grant BMS-71-01540-A02.

Descriptors: *Environmental effects, Management, *Fish management, Population, *Crayfish, Reproduction, Experimental fishery, Maximum Sustained Yield.

The objectives of the study were to determine the effects of exploitation on a population of freshwater crayfish and to evaluate maximum sustained yield (MSY) as a possible method for managing crayfish populations. In one lake, yield was increased by overfishing in 1974 and 1975 (with the yield dropping in 1975 but still above average) but evidence of overfishing became noticeable when the age composition of the catch was examined. Increased stress on the population suppressed the normal growth response. This decrease in growth rates was reflected in the mean size of individuals at a given age and the poor production of recent cohorts. In another lake, a 300 trap-day effort was retained in 1974 and 1975 but, due to failing recruitment, a 20% over harvest occurred in 1974 and a drastic over harvest in 1975. It was concluded that changes in productivity during the period of exploitation (related to loss of microhabitat for hatchlings) offset the benefits of MSY management. (Chilton-ORNL)

W78-04125

ENERGY, WATER AND TRITIUM BUDGETS FOR PERCH LAKE: 1974,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.

For primary bibliographic entry see Field 5C.

W78-04128

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE KEWAUNEE NUCLEAR POWER PLANT SITE,

Argonne National Lab., IL.

For primary bibliographic entry see Field 5C.

W78-04132

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE ZION NUCLEAR POWER STATION SITE,

Argonne National Lab., IL.

For primary bibliographic entry see Field 5C.

W78-04134

FEEDING ECOLOGY OF THE BLUEGILL, LEPOMIS MACROCHIRUS, IN TWO HEATED RESERVOIRS OF TEXAS, III. TIME OF DAY AND PATTERNS OF FEEDING,

Bangladesh Agricultural Univ., Mymensingh. Faculty of Fisheries.

A. L. Sarker.

Transactions of the American Fisheries Society, Vol. 106, No. 6, p 596-601, 1977. 16 ref, 3 fig.

Descriptors: *Sunfishes, *Aquaculture, *Diurnal, *Biorhythms, *Feeding rates, *Heated water, *Environmental effects, *Aquatic insects, *Fish behavior, Distribution, Fish food organisms, Powerplants, Ecological distribution, Texas, Seasonal, Insects, Crustaceans, Effluent streams, Fish diets, Lepomis macrochirus.

The times and patterns of feeding of 1,366 bluegill in two heated reservoirs of Texas were studied by the 'points' method for over a year. Fish were collected on alternate hours from an electric power plant discharge canal and an open-water station in each reservoir over 24-hour periods. Both average index of fullness of the stomachs and average points per fish showed that a similar diet pattern of feeding. The fish were largely diurnal feeders with a nocturnal component. The stomachs contained least food during the period from 0200 h to 0800 h. Feeding increased after sunrise, and the fish showed a minor peak by 0900-1000 h and a major peak by 1800-1900 h. A gradual decline in food volume began after 1900 h and continued until

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2200 h followed by a sharp decline at 2300 h. A diverse range of food organisms was consumed by the fish during the daylight hours. Planktonic crustaceans and nonaquatic organisms were rarely found in the stomachs of the fish taken at night. In the discharge-canal fish, 75% fullness of the stomachs occurred by 0900 h, but in fish from the open waters, comparable stomach fullness did not occur until 1400-1600 h. (Katz)
W78-04139

PALAEOECOLOGICAL STUDIES OF THE RECENT DEVELOPMENT OF LAKE VAX-JOSJON II. SETTLEMENT AND LANDSCAPE DEVELOPMENT,
Kvarterbiologiska Labs, Lund (Sweden).
For primary bibliographic entry see Field 5C.
W78-04152

REPORT OF A WORKSHOP ON THE IMPACT OF THERMAL POWER PLANT COOLING SYSTEMS ON AQUATIC ENVIRONMENTS.
Sigma Research Inc., Richland, WA.
For primary bibliographic entry see Field 5C.
W78-04155

AQUATIC LIFE IN TEXAS RESERVOIRS,
Texas Electric Service Co., Fort Worth.
For primary bibliographic entry see Field 5C.
W78-04172

MERCURY IN WATERS AND BOTTOM SEDIMENTS OF SOME SELECTED MAZURIAN LAKES,
Akademia Rolniczo-Techniczna, Olsztyn-Kortowo (Poland). Inst. of Agrochemistry.
For primary bibliographic entry see Field 5A.
W78-04184

FISH POPULATION STRUCTURE IN ARCTIC LAKES,
Laval Univ., Quebec. Centre d'Etudes Nordiques. G. Power.
Journal of the Fisheries Research Board of Canada, Vol. 35, No. 1, January 1978, p 53-59, 6 fig, 9 ref.

Descriptors: *Model studies, Fish population, Lakes, Growth rates, Aging(Biological), *Fish population, *Distribution patterns, *Arctic lakes, *Salvelinus namaycush*, *Coregonus clupeaformis*, *Lake trout, *Lake whitefish.

A model is developed to demonstrate an explanation of the observed structure of arctic lake fish populations. It is suggested that existing theories accounting for the predominance of older, larger individuals and the bimodal character of the length-frequency distribution of unexploited populations are in error due to problems in age determination of the populations. Growth rates of fish are seen to be rapid until first maturity after which time it becomes slow. Mortalities decline rapidly through early life and stabilize at a low level through most of the life span. These growth and mortality patterns produce a population of many small, few intermediate, and many large fish. This information is compared with observations from several lakes in northern Quebec. (Chilton-ORNL)
W78-04187

PHYTOPLANKTON SUMMER STANDING CROP AND ANNUAL PRODUCTIVITY AS FUNCTIONS OF PHOSPHORUS LOADING AND VARIOUS PHYSICAL FACTORS,
Cornell Univ., NY. Dept. of Natural Resources.
For primary bibliographic entry see Field 5C.
W78-04189

SEDIMENT CONTAMINATION AND BENTHIC MACROINVERTEBRATE DISTRIBUTION IN A METAL-IMPACTED LAKE,
Purdue Univ., Lafayette, Ind. Dept. of Bionucleonics.
For primary bibliographic entry see Field 5C.
W78-04193

2I. Water In Plants

FUNGI AS A COMPONENT OF FRESHWATER BIOECENOSSES, (IN RUSSIAN),
Akademiya Nauk UkrSSR, Kiev. Inst. Botaniki. I. A. Dudka.
Mikol Fitopatol. 8(5), p 444-449, 1975.

Descriptors: *Aquatic fungi, *Food chains, Organic matter, *Trophic level, Aquatic plants, Biodegradation, *Decomposing organic matter, Ascomycete, *Asterionella formosa*, *Biocenoses(Freshwater), Deuteromycete, Fish, Hyphomycetes, Moniliaceae, Parasitism, Phycomycetes, Rhizophydium planktonicum.

The role of fungi in freshwater biocenoses is discussed with an emphasis on literature data. Both freshwater fungi and fungi which are 'active migrants' are primary consumers in the trophic chain, participating in the decomposition of allochthonous and autochthonous organic substances. The typical freshwater fungi include lower fungi, Ascomycetes, Deuteromycetes and Hyphomycetes, developing on plant remains in water. Active migrants include Ascomycetes and Moniliaceae which usually develop on shore plants and in soil. Both types of fungi affect biocenoses by fungal parasitism of various aquatic organisms (development of Rhizophydium planktonicum on *Asterionella formosa* and of Saprolegniales (Oomycetes) on nekton, especially fish), in producing various physiologically active metabolites and in changing the intensity of abiogenic factors. The role of fungi in the formation of aquatic biocenoses and their role in the trophic chain and transformation of substances is determined by the type of body of water, i.e., all complex abiotic and biotic factors characteristic for a biotope. A tendency for fungal complexes to be specific for (characteristic of) planktonic, benthic and neuston communities was noted. Copyright 1975, Biological Abstracts, Inc.
W78-04042

2J. Erosion and Sedimentation

HYDRAULIC DREDGING AS A LAKE RESTORATION TECHNIQUE: PAST AND FUTURE,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.
W78-03747

FIELD GUIDE TO THE GEOLOGY OF THE DURHAM TRIASSIC BASIN, NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.; and Campbell Coll., Buie's Creek, NC. G. L. Bain, and B. W. Harvey.
North Carolina Department of Natural Resources and Community Development, Raleigh, 1977. 83 p, 24 fig, 57 ref, 2 append.

Descriptors: *Geophysics, *Sedimentation, *Data collections, *North Carolina, *Geologic formations, Faults(Geologic), Playas, Chert, Coals, Hydrogeology, Fluvial sediments, Resistivity, Gravity, Seismic properties, *Durham Triassic basin(NC).

The geophysical data from the Durham basin in North Carolina, describe a fault graben more complex than previously thought. The fault that produced it probably was a deep crustal one ex-

pressed at the surface as a series of en echelon positive fault blocks which supplied sediment and negative ones which received that sediment. The irregular linear basin which resulted contains a spatial facies distribution controlled by the then existing combination of tectonic-climate elements. The Colon cross-structure was negative during Pekin time, and the locus of a restricted lacustrine-playa facies. In Cumnock time the area west of Sanford was alternately a vast bog and lake wherein the Cumnock coal and black shale accumulated. Still later, thin lacustrine shale, chert, and limy red beds accumulated in a lacustrine-playa environment in the Research Triangle Park area. All of these facies grade laterally into maroon, coarse, less sorted rock at the basin's margins and into a coarse, tan, arkosic, fluvial sandstone for which the tentative paleocurrent data indicate a major extra-basin source to the northeast for much of the Durham basin. The basin was sliced and rotated along northeast-trending fracture zones and cross-faulted along a north-to-northeast fracture set resulting in an intrabasin horst-and-graben structural character. Individual horsts and grabens are triangular to diamond shaped and pitch to the east and southeast. A few pitch north. Diabase dikes intruded the rotated sediment pile and were in turn faulted and offset by later tectonic adjustments in the Piedmont. The step-faulted border is probably a post-depositional phenomenon. (Woodard-USGS)
W78-03760

ANALYSES OF NATIVE WATER AND DREDGED MATERIAL FROM SOUTHERN LOUISIANA WATERWAYS, 1975-76,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W78-03779

COMPUTATION OF RESERVOIRS SEDIMENTATION,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR). A. V. Karashev, and I. V. Bogoliubova.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 199-205, 1974. 1 fig, 5 ref.

Descriptors: *Reservoir siltation, *Sediment load, *Estimating, *Mathematical models, Sedimentation, Bed load, Suspended load, Reservoirs, Equations, Methodology, Foreign research, Foreign countries, *USSR.

Methods for the computation of sedimentation by suspended sediments and bed load of the projected reservoirs were given. For the first year of the reservoir operation, computation was made according to the balance of sediments computed by the difference between the transport capacity and the hydraulic parameters of the current at the upper pool (transient region) and at the dam of the reservoir. The subsequent attenuation of the process, as well as the total duration of sedimentation, was evaluated by empirical relations obtained from the observational data on reservoirs under operation. (See also W78-03783) (Humphreys-ISWS)
W78-03792

ESTIMATION OF FLOODS BY MEANS OF THEIR SILT LOADS,
For primary bibliographic entry see Field 4A.
W78-03800

A METHOD FOR THE PREDICTION OF WASHLOAD IN CERTAIN SMALL WATERSHEDS,
For primary bibliographic entry see Field 4D.
W78-03810

Field 2—WATER CYCLE

Group 2J—Erosion and Sedimentation

RECENT SEDIMENTATION AND RESUSPENSION OF ORGANIC MATTER IN EUTROPHIC LAKE ESRØM, DENMARK,
Copenhagen Univ. (Denmark). Freshwater Biological Lab.
For primary bibliographic entry see Field 5C.
W78-03834

AGING AND EVALUATION OF TWIN LAKES SEDIMENTS,
Colorado Cooperative Fishery Unit, Fort Collins.
E. P. Bergensen.
In: Studies of the Benthic Environment of Twin Lakes, Colorado, October 1976. p 29-39, 7 fig. 6 tab, 8 ref. REC-ERC-76-12.

Descriptors: *Sediments, *Deposition(Sediments), *Geologic history, *Twin Lakes(CO), Powerplants, Colorado, Lakes, Eutrophication, Shrimp, Lake trout, Environmental effects, Sedimentation rate, Suspended solids, Glacial sediments.

Construction of the Mt. Elbert Pumped-Storage Powerplant on the lower lake of Twin Lakes, Colorado may cause continuous resuspension of bottom sediments, with significant alteration of the biological community structure; opossum shrimp and lake trout in particular may be affected. To document these effects, recent sedimentation rates, sediment composition, and the biological history of recent sediments were studied through 24 bottom samples (seven from the upper lake and 17 from the lower) collected with a core freezer. A glacial flour covering the bottom is extremely sensitive to disturbance, and remains suspended for a considerable time. Sediment size is similar in the lakes, but mean total carbon (percent by weight) is significantly higher in the upper lake, especially in recent sediments, indicating that the upper lake has served as a nutrient trap. This premise is also supported by the fact that, of 48 elements surveyed, high concentrations are more often found in the upper lake than in the lower lake. Of copper, lead, zinc, and silver, only copper differs in concentration profile between the lakes, with concentrations in the upper lake increasing in recent sediments. About 49-96 mm sediments have been deposited since placer mining in the area began in 1859 (0.63 mm/yr). The araphidinea to centrale (A/C) diatom ratio, a measure of eutrophication, showed a sudden increase in the upper lake about the time mining activities began. (See also W77-07806) (Lynch-Wisconsin) W78-03839

TRANSPORT OF GRANITIC SEDIMENT IN STREAMS AND ITS EFFECTS ON INSECTS AND FISH,
Cooperative Fisheries Research Unit, Moscow.
T. C. Bjornn, M. A. Brusven, M. P. Molnau, J. H. Milligan, and R. A. Klamt.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 197, Price codes: A04 in paper copy, A01 in microfiche. University of Idaho, Forest, Wildlife and Range Experiment Station, Bulletin No 17, September 1977. 43 p, 64 fig, 17 tab, 40 ref. OWRT B-036-ID(A2). 14-31-0001-5069/4012.

Descriptors: *Sediment transport, *Sediment loads, *Benthos, *Idaho, Salmonids, *Aquatic insects, Seasonal, Stoneflies, Mayflies, Streams, Equations, Stream channels.

Assessment was made of the transport of granitic bedload sediment (< 6.35 mm diameter) in streams flowing through central Idaho mountain valleys and the effects of the sediment on juvenile salmonids and aquatic insects. Measurements were made of bedload sediment transported in the streams during the spring snowmelt runoff and the summer lowflow periods for 2 yrs., to test the applicability of the Meyer-Peter, Muller equation for estimating such transport. The modified Meyer-Peter, Muller equation was accurate in estimating

the transport capacity of such streams using measurements of slope, hydraulic radius and mean diameter of streambed material. In artificial stream channels, benthic insect density in fully sedimented riffles (> 2/3 cobble imbeddedness) was one-half that in unsedimented riffles, but the abundance of drifting insects in the sedimented channels was not significantly smaller. In a natural stream riffle, benthic insects were 1.5 times more abundant in a plot cleaned of sediment, with mayflies and stoneflies 4 and 8 times more abundant, respectively. During both summer and winter, fewer fish remained in the artificial stream channels where sediment was added to the pools. W78-03928

TURBIDITY AND SEDIMENT-RATING CURVES FOR STREAMS ON OAHU, HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.

P. C. Ekern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 358, Price codes: A02 in paper copy, A01 in microfiche. Reprint from: Soil Erosion; Prediction and Control, (Soil Conservation Society of America) 1976, p 242-254, 6 fig, 4 tab, 62 ref. OWRT A-039-HI(1), 14-31-0001-5011.

Descriptors: *Turbidity, *Suspended load, *Optical density, Light transmissivity, Small watersheds, Runoff, Streams, *Sediment load, Suspended solids, Hawaii, *Sediment-rating curves, *Oahu(Hawaii).

The sharp, short-duration peaks, of runoff from small Hawaiian watersheds make them particularly sensitive to sediment concentration and runoff discharge interrelationships. However, concentration of sediment in the streams is relatively low, despite high rainfall erosional hazard. This low concentration must stem in part from the low erosion susceptibility of the aggregated red clays that make up the watersheds. The low transmittance and high back scatter of these red clays preclude the measurement of turbidity as a field index of sediment concentration, though turbidity can serve as a laboratory index of sediment concentration in diluted samples. This low transmittance and high scatter make even low concentrations of sediment very detrimental to the optical properties that determine water quality. W78-03931

METHODOLOGICAL CONSIDERATIONS IN WESTERN LAKE SUPERIOR WATER-SEDIMENT EXCHANGE STUDIES OF SOME TRACE ELEMENTS,
National Water Quality Lab., Duluth, MN.
For primary bibliographic entry see Field 5A.
W78-03985

ACCURACY IN DETERMINING TRACE ELEMENT CONCENTRATIONS IN MARINE SEDIMENTS,
Puerto Rico Nuclear Center, Mayaguez.

For primary bibliographic entry see Field 5A.
W78-03986

ECOLOGICAL LAND UNITS OF BEAR CREEK WATERSHED AND THEIR RELATIONSHIP TO WATER QUALITY,
Oregon State Univ., Corvallis. Water Resources Research Inst.

For primary bibliographic entry see Field 4D.
W78-04099

THE EFFECTS OF WOOD DEBRIS AND DRIFT LOGS ON ESTUARINE BEACHES OF NORTHERN PUGET SOUND,
Western Washington State Coll., Bellingham. Dept. of Geography and Regional Planning.

For primary bibliographic entry see Field 2L.
W78-04103

MERCURY IN WATERS AND BOTTOM SEDIMENTS OF SOME SELECTED MAZURIAN LAKES,
Akademia Rolniczo-Techniczna, Olsztyn-Kortowo (Poland). Inst. of Agrochemistry.

For primary bibliographic entry see Field 5A.
W78-04184

2K. Chemical Processes

OCCURRENCE AND DISTRIBUTION OF COLOR AND HYDROGEN SULFIDE IN WATER FROM THE PRINCIPAL ARTESIAN AQUIFER IN THE VALDOSTA AREA, GEORGIA,
Geological Survey, Doraville, GA. Water Resources Div.

For primary bibliographic entry see Field 5B.
W78-03980

GROUND-WATER RESOURCES OF CENTRAL AND SOUTHERN YORK COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W78-03771

WATER RESOURCES OF OKALOOSA COUNTY AND ADJACENT AREAS, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-03774

PRELIMINARY EVALUATION OF GROUND WATER IN THE PRE-PENNSYLVANIAN CARBONATE ROCKS, MCCOY AREA, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-03776

ANALYSES OF NATIVE WATER AND DREDGED MATERIAL FROM SOUTHERN LOUISIANA WATERWAYS, 1975-76,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W78-03779

THE USE OF ION EXCHANGE METHODS FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS: VII. COPPER, (IN GERMAN),
For primary bibliographic entry see Field 5A.
W78-03939

THE USE OF ION EXCHANGE METHODS FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS: VI. ZINC, (IN GERMAN),
For primary bibliographic entry see Field 5A.
W78-03944

THE USE OF ION EXCHANGE METHODS FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS: V. LEAD, (IN GERMAN),
For primary bibliographic entry see Field 5A.
W78-03955

AN INVESTIGATION OF USING DERIVATION REACTION GAS CHROMATOGRAPHY TO MEASURE ANIONIC WATER QUALITY PARAMETERS,
Arkansas Univ. at Little Rock. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W78-03961

ACCURACY PLING, VOLUME National B For primary W78-03979

SAMPLIN MINATION WATER, Reactor C For primary W78-03982

ANALYTIC WATERS, Battelle-Pitt For primary W78-03982

MONITORING WATER ELECTRO... Texas Ins... Lab. For primary W78-03984

ELECTR... AND CHA... METALS Institut R Center for For primary W78-03984

ORGANIC CONTENT AS DETER... ANALYST Pavia U... Analisi per... For primary W78-03984

GROUND TECHNI... TION, Guam U... Center. For primary W78-0410

WATER TREATMENT For primary W78-041

MERCURY THE EL... Hamburg Hydrobi... For primary W78-037

BASELINE METALS Washington For primary W78-037

FINAL P... MENT A... LUTION TAL SH... Harry Di... For primary

WATER CYCLE—Field 2

Estuaries—Group 2L

ACCURACY IN TRACE ANALYSIS: SAMPLING, SAMPLE HANDLING, ANALYSIS. VOLUME II.

National Bureau of Standards, Washington, DC.
For primary bibliographic entry see Field 5A.
W78-03979

SAMPLING PROBLEMS AND THE DETERMINATION OF MERCURY IN SURFACE WATER, SEAWATER, AND AIR.

Reactor Centrum Nederland, Petten.

For primary bibliographic entry see Field 5A.

W78-03980

ANALYTICAL CHEMISTRY OF NATURAL WATERS,

Battelle-Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5A.

W78-03982

MONITORING DISSOLVED COPPER IN SEA-WATER BY MEANS OF ION-SELECTIVE ELECTRODES,

Texas Instruments Inc., Dallas. Central Research Lab.

For primary bibliographic entry see Field 5A.

W78-03983

ELECTROANALYTICAL DETERMINATION AND CHARACTERIZATION OF SOME HEAVY METALS IN SEAWATER,

Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.

For primary bibliographic entry see Field 5A.

W78-03984

ORGANOMERCURY AND TOTAL MERCURY CONTENT OF ENVIRONMENTAL MATRICES AS DETERMINED BY NEUTRON ACTIVATION ANALYSIS,

Pavia Univ. (Italy). Centro di Radiochimica e Analisi per Attivazione.

For primary bibliographic entry see Field 5A.

W78-03987

GROUNDWATER ANALYSIS BY TRITIUM TECHNIQUE: A PRELIMINARY EVALUATION,

Guam Univ., Agana. Water Resources Research Center.

For primary bibliographic entry see Field 2F.

W78-04100

WATER RESEARCH INSTRUMENTATION: 2.

For primary bibliographic entry see Field 5A.

W78-04153

2L. Estuaries

MERCURY IN BENTHIC INVERTEBRATES OF THE ELBE ESTUARY,

Hamburg Univ. (West Germany). Inst. fuer Hydrobiologie und Fishcherei-wissenschaft.

For primary bibliographic entry see Field 5B.

W78-03705

BASELINE STUDY OF TRACE HEAVY METALS IN BIOTA OF PUGET SOUND,

Washington Univ., Seattle. Coll. of Fisheries.

For primary bibliographic entry see Field 5A.

W78-03719

FINAL REPORT: RESEARCH AND DEVELOPMENT ASSESSMENT ON SAFETY AND POLLUTION CONTROL FOR OUTER CONTINENTAL SHELF OPERATIONS,

Harry Diamond Labs., Adelphi, MD.

For primary bibliographic entry see Field 5G.

W78-03720

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES, PROCEEDINGS OF THE SECOND U.S.-JAPAN EXPERTS' MEETING, OCTOBER 1976—TOKYO, JAPAN.

Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.

W78-03735

COUNTERMEASURES FOR POLLUTION IN TOKYO BAY,

Ministry of Transport, Yokohama (Japan). Bureau of Port Construction.

For primary bibliographic entry see Field 5G.

W78-03737

DEVELOPMENT OF AN ASSESSMENT METHODOLOGY FOR GEOPRESSED ZONES OF THE UPPER GULF COAST BASED ON A STUDY OF ABNORMALLY PRESSURED FIELDS IN SOUTH TEXAS,

Southwest Research Inst., San Antonio, TX.

For primary bibliographic entry see Field 8B.

W78-03863

PLANKTON OF COASTAL LAGOONS: VI. SEASONAL DISTRIBUTION OF PHYTOPLANKTON IN THE YAVAROS LAGOON, SONORA, MEXICO (1969-1970), (IN SPANISH),

Universidad Nacional Autonoma de Mexico City. Inst. de Biologia.

For primary bibliographic entry see Field 5B.

W78-03866

ANALYSIS OF MICROGRAM/KG (PPB) LEVEL HYDROCARBONS IN INTERTIDAL ZONE SEDIMENTS AND WATER BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,

National Bureau of Standards, Washington, DC. Bioorganic Standards Section.

For primary bibliographic entry see Field 5A.

W78-03869

THE STATE OF METAL IONS IN SEAWATER,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.

For primary bibliographic entry see Field 5A.

W78-03870

SOLUTION CHEMISTRY, SOLUBILITY, AND ADSORPTION EQUILIBRIA OF IRON, COBALT, AND COPPER IN MARINE SYSTEMS,

Rhode Island Univ., Kingston. Graduate School of Oceanography.

For primary bibliographic entry see Field 5A.

W78-03871

PERIODIC PHENOMENA AT THE MOUTH OF THE MISSISSIPPI RIVER,

Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

For primary bibliographic entry see Field 5B.

W78-03872

WASTE DISPERSION CHARACTERISTICS AND EFFECTS IN AN OCEANIC ENVIRONMENT,

Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Engineering Dept.

For primary bibliographic entry see Field 5C.

W78-03874

DREDGE DISPOSAL STUDY. SAN FRANCISCO BAY AND ESTUARY. MAIN REPORT.

Army Engineer District, San Francisco.

For primary bibliographic entry see Field 5E.
W78-03875

NATURAL HAZARD MANAGEMENT IN COASTAL AREAS,

Colorado Univ., Boulder. Inst. of Behavioral Science.

For primary bibliographic entry see Field 5G.

W78-03879

MISSISSIPPI SOUND TEMPORAL AND SPACIAL DISTRIBUTION OF NUTRIENTS,

Gulf Coast Research Lab., Ocean Springs, MS.

For primary bibliographic entry see Field 5B.

W78-03880

REMOTE SENSING OPERATIONS (MULTISPECTRAL SCANNER AND PHOTOGRAPHIC) IN THE NEW YORK BIGHT, SEPTEMBER 22, 1975,

National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center.

For primary bibliographic entry see Field 5B.

W78-03881

MARINE STUDIES OF SAN PEDRO, CALIFORNIA. PART II. POTENTIAL EFFECTS OF DREDGING ON THE BIOTA OF OUTER LOS ANGELES HARBOR. TOXICITY, BIOASSAY AND RECOLONIZATION STUDIES.

University of Southern California, Los Angeles.

Allan Hancock Foundation; and University of Southern California, Los Angeles. Inst. of Marine and Coastal Studies.

For primary bibliographic entry see Field 5C.

W78-03882

POTENTIAL BIOLOGICAL EFFECTS OF HYDRAULIC DREDGING IN LOS ANGELES HARBOR: AN OVERVIEW,

University of Southern California, Los Angeles.

For primary bibliographic entry see Field 5C.

W78-03883

EFFECTS OF POLLUTANTS ON SUBMARINE PLANT SYNOECOLOGY,

Western Washington State Coll., Bellingham.

For primary bibliographic entry see Field 5C.

W78-03922

EFFECT OF HURRICANE ELOISE ON THE BENTHIC FAUNA OF PANAMA CITY BEACH, FLORIDA, USA,

National Marine Fisheries Service, Panama City, FL. Panama City Lab.

C. H. Salomon, and S. P. Naughton.

Marine Biology, Vol. 42, p. 357-363, 1977. 3 fig, 4 tab, 24 ref.

Descriptors: *Hurricanes, *Storms, *Benthic fauna, *Benthos, *Salinity, *Damages, *Erosion, *Turbulence, *Sediments, *Biological communities, *Dominant organisms, *Ecological distribution, Invertebrates, *Anomura, *Emerita, *Polychaetes.

The effect of the storm on the benthic invertebrates was not adverse, as the number of individuals occurring in the swash zone was about the same after the storm as before. The number of species increased after the storm, but later decreased to approximate numbers before the storm. The increase in the number of species was mainly due to the influx of species that normally occur farther offshore of the swash zone. The lack of heavy rainfall that usually accompanies a hurricane was probably a factor enabling benthic organisms that normally live in high salinities to survive. (Katz)
W78-03946

Field 2—WATER CYCLE

Group 2L—Estuaries

LAGUNA DE BAY WATER RESOURCES DEVELOPMENT,
Bureau of Experts, Sogreh, Grenoble, France.
For primary bibliographic entry see Field 5G.
W78-03994

PLANKTON STUDIES IN A MANGROVE ENVIRONMENT: VIII. FURTHER INVESTIGATIONS ON PRIMARY PRODUCTION, STANDING-STOCK OF PHYTO- AND ZOOPLANKTON AND SOME ENVIRONMENTAL FACTORS, Universidade Federal Sao Carlos, Sao Paulo (Brazil). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W78-04017

STUDIES OF SUBTERRANEAN WATERS: 25. METHODS OF COLLECTING INTERSTITIAL SUBTERRANEAN WATERS, (IN FRENCH), Centre National de la Recherche Scientifique, Moulis (France). Lab. Souterrain.
For primary bibliographic entry see Field 7B.
W78-04024

BIOLOGICAL STUDY OF THE SUBMARINE SHELF OF CATALONIA, (IN SPANISH), Barcelona Univ. (Spain). Catedra Botany.
J. J. Seoane-Camba, and L. Polo.
An Inst Bot A J Cavanilles. 31, p 179-184, 1974.

Descriptors: *Biological balance (Algae-fish), Herbivores. Distribution, *Algae, *Catalonia (Spain), Crustaceans, Cystoseira, Fish, Lithophyllum, Mollusk, Perch, *Primary production, Sarpa-sarpa, Sphaeraria, Submarine shelf.

Major changes in the biological balance between algae and fishes living in depths (Catalonia, Spain) from 0-10 m were examined in a study conducted in 1972 and compared to similar studies done in 1956. An increase in herbivorous fishes, especially Sarpa salpa, and a decrease in species of algae was related to the reduction in the number of predators (carnivorous fishes) of herbivores. This reduction was due to recent economic exploitation of the giant perch by local fishermen, creating a missing link in the food chain and directing the main energy of the ecosystem toward herbivorous fish. The effect on crustacean and molluscan forms living in algae and the impact on primary production were examined. The distribution of Cystoseira, Sphaeraria and Lithophyllum and the selectiveness of fishes for certain algal forms were discussed.—Copyright 1975, Biological Abstracts, Inc.
W78-04043

EFFECTS OF CHEMICAL POLLUTION ON TELEMEDIATORS INTERVENING IN THE MICROBIOLOGICAL AND PLANKTONIC ECOLOGY IN A MARINE ENVIRONMENT, PART II, (IN FRENCH), Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France).
For primary bibliographic entry see Field 5C.
W78-04044

ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON: IX. STUDIES RELATING TO THE NUTRITION OF OVER-WINTERING CALANUS, Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.
For primary bibliographic entry see Field 5C.
W78-04045

COMPARATIVE ANALYSIS OF THE NUTRITION OF BRACKISH-WATER WHITE-FISH IN THE LAPTEV SEA: III. THE FEEDING OF WHITEFISH DURING THE SUMMER-AUTUMN PERIOD IN BUORKHAYA GULF AND

GENERAL CONCLUSION OF THE THREE PARTS, (IN RUSSIAN), Moscow State Univ. (USSR). Faculty of Biology and Soil Science.
V. V. Kuznetsov.
Vestn Mosk Univ Ser Vi Biol Pochvoved 30(1), p 26-33, 1975.

Descriptors: *White-fish, Seasonal, Laptev Sea (USSR), Autumn, Brackish water, Coregonus-autumnalis, Coregonus-muksun, Coregonus-sardinella, Ecological distribution, *Nutrition, Summer, USSR.

The feeding of Coregonus autumnalis, C. sardinella and 3 brackish water forms of C. muksun (multispinatus, oligospinatus and macrostomatus forms) was studied. Substantial differences in the utilization of food resources by different forms is shown. The ecological niches of 5 brackish water whitefishes of the Laptev Sea (USSR) are described.—Copyright 1975, Biological Abstracts, Inc.
W78-04046

THE EFFECTS OF WOOD DEBRIS AND DRIFT LOGS ON ESTUARINE BEACHES OF NORTHERN PUGET SOUND, Western Washington State Coll., Bellingham. Dept. of Geography and Regional Planning.
T. A. Terich, and S. Milne.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 736. Price codes: A04 in paper copy, A01 in microfiche. Completion Report, December 1977. 67 p, 1 fig, 4 tab, 3 ref, 7 append. OWRT A-089-WASH(1).

Descriptors: *Wood debris, *Drift logs, Beaches, Erosion, *Puget Sound (Wash), Washington, Estuarine environment, Land clearing, Clear-cutting.

Large volumes of wood debris and logs are washed from forested slopes and clear cut sites into Pacific Northwest streams and rivers. Their concentrations often significantly alter stream physiography and flow. Similar effects may occur along the shorelines of Puget Sound, the depositary for much river-borne debris. This study has been designed to investigate the effects wood debris have on beaches, particularly erosion and deposition. Drift logs exhibit seasonal profile changes. Log masses are 'packed' in greater densities and higher on the beach berm in the winter than in the summer, reflecting higher wave energies. Concentrations of drift logs help to stabilize beaches by capturing beach sediment and shielding the shore from wave attack.
W78-04103

POWER PRODUCTION ON ESTUARIES AND TIDAL RIVERS, Virginia Electric and Power Co., Richmond.
For primary bibliographic entry see Field 5C.
W78-04158

RELEASE OF MERCURY AND ORGANICS FROM RESUSPENDED NEAR-SHORE SEDIMENTS, Florida State Univ., Tallahassee.
For primary bibliographic entry see Field 5C.
W78-04192

OCCURRENCE OF METHYL MERCURY IN PIKE AND BALTIC HERRING FROM THE TURKU ARCHIPELAGO, Turku Univ. (Finland). Inst. of Biochemistry.
For primary bibliographic entry see Field 5C.
W78-04194

WATER QUALITY IN THE FORTH ESTUARY: A DISCRIMINANT FUNCTIONAL ANALYSIS, Napier Coll. of Commerce and Technology, Edinburgh (Scotland).

For primary bibliographic entry see Field 5A.
W78-04199

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3C. Use Of Water Of Impaired Quality

IMPACT OF GROUNDWATER DEVELOPMENT IN ARID LANDS: A LITERATURE REVIEW AND ANNOTATED BIBLIOGRAPHY, Arizona Univ., Tucson. Office of Arid Lands Studies.

For primary bibliographic entry see Field 4B.
W78-03757

3D. Conservation In Domestic and Municipal Use

CLASSIFICATION OF AMERICAN CITIES FOR CASE STUDY ANALYSIS: VOLUME I. SUMMARY REPORT, Urban Systems Research and Engineering, Inc., Cambridge, MA.

For primary bibliographic entry see Field 6A.
W78-03918

COMMERCIAL AND INSTITUTIONAL WATER USE IN PUERTO RICO, Puerto Rico Univ., Mayaguez. School of Engineering.

For primary bibliographic entry see Field 6B.
W78-04097

RUNOFF POLLUTION FROM MULTIPLE FAMILY HOUSING, Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.

For primary bibliographic entry see Field 5B.
W78-04102

3E. Conservation In Industry

THE PHASED CLEAN-UP PROGRAM, KANAWHA RIVER, For primary bibliographic entry see Field 5G.
W78-03821

1977 REVIEW, 1978 PREVIEW. For primary bibliographic entry see Field 4B.
W78-03848

WATER CONSERVATION: DRAMATIC CHANGES TAKING PLACE, Eutek, Inc., San Francisco, CA.
G. E. Wilson and J. Y. Huang.
Food Engineering, Vol. 49, No. 6, p 79-81, June, 1977. 1 fig.

Descriptors: *Water conservation, *Foods, *Canneries, *Industrial water, Industrial wastes, Water pollution control, Cooling water, Water reuse, Flumes, *Food processing industry.

With the advent of the 1976/77 drought in the United States, there has been a growing awareness that potable water is a limited valuable resource which cannot be wasted. This awareness, coupled with the pressures of federal pollution controls and restructured water rates, has led to dramatic shifts in the water use patterns of the food processing industry. To date, the major cost-effective water conservation measures undertaken can be generally classified under the areas of: (1) use

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WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Conservation In Agriculture—Group 3F

consciousness; (2) cooling water conservation; (3) counter-current reuse of process flume water. Efforts of food processing firms to comply with the best Practical Technology requirements of the 1972 Water Pollution Control Act have brought about overwhelming reductions in water waste throughout the industry. There are, in fact, a number of published case studies describing how certain firms have achieved the ultimate objective of zero wastewater discharge. Such changes in use patterns are expected to continue in the near future as rapidly as during the past half decade. (Eberle-NWWA)

W78-03851

ENVIRONMENTAL ASSESSMENT OF GEOPRESURED WATERS AND THEIR PROJECTED USES,
Dow Chemical U. S. A., Freeport, TX. Texas Div. For primary bibliographic entry see Field 4B. W78-03857

ENERGY DEVELOPMENT AND LAND USE IN TEXAS,

Texas Transportation Inst., College Station. E. K. Smith, W. F. McFarland, and A. Gonzales. Available from the National Technical Information Service, Springfield, VA 22161 as PB-243 328. Price codes: A07 in paper copy, A01 in microfiche. Prepared for Governor's Energy Advisory Council of Texas, Austin, January 1975, 122 p, 7 tab, 12 fig.

Descriptors: *Energy, *Land use, *Legal aspects, *Electric power production, *Texas, Value, Oil, Natural gas, Coals, Uranium, Environmental effects, Distribution patterns.

This report provides an overview of the relationships between the development of different energy sources and land use and land value. A brief review of the legal aspects of land use in Texas is presented as a basis for understanding present land use patterns in Texas and possible land use patterns of the future that may result from alternative energy policies. The land use impacts of primary energy sources in Texas are examined, including oil, natural gas, coal, and uranium. These impacts are viewed from the levels of the land use requirements of the production, distribution and utilization of the alternative energy sources, and the effect of these activities on surrounding land use and land values. The land use related impacts of electrical power generation and transmission in Texas are discussed. Alternative energy development scenarios for Texas are evaluated. Land use requirements of the different scenarios are presented and the impacts on land use of the scenarios are compared. The critical concerns surrounding development of the different energy sources are summarized. Possible policy strategies are presented that would insure that the land resources of Texas continue to be used in the most beneficial manner. (Nessa-NC)

W78-03900

WATER CONSERVATION IN INDUSTRIAL FILTRATION OPERATIONS,
Arkansas Univ., Fayetteville. Coll. of Engineering. For primary bibliographic entry see Field 5D. W78-03932

ABITIBI (PAPER COMPANY LTD.) IN SMOOTH ROCK FALLS (ONTARIO) REAPS THE BENEFITS OF IMPROVED WASTE TREATMENT,
L. Armstrong.
Canadian Pulp and Paper Industry, Vol. 30, No. 13, p 22-25, September 5, 1977. 10 illus.

Descriptors: *Pulp wastes, *Waste water treatment, *Treatment facilities, Wastes, Industrial wastes, Water pollution treatment, Water pollu-

tion sources, Foreign countries, Canada, *Boilers, Generators, Pulp and paper industry, Effluents, Electric power, Water reuse, *Water conservation, *Recycling, Water consumption (Except consumptive use), *Kraft mills, Clarifiers.

The \$10,000,000 energy and environment improvement program at Abitibi's bleached kraft pulp and stud mill in Smooth Rock Falls, Ontario, includes startup of a Babcock-Wilcox refuse boiler, a Westinghouse (steam-driven) turbine generator, and an Eimco Envirotech effluent clarifier. Effluent from the pulp mill's screening operation plus the fines from the bark screen room are processed by the clarifier. The sludge (45% consistency) and wood waste from the stud mill are burned in the refuse boiler. Power generation by the steam- and two water-driven turbine generators is sufficient to meet Abitibi's needs. Recycling water from the clarifier and countercurrent washing in the bleach plant have cut water consumption to 44,000 gal/ton of pulp. (Swichtenberg-IPC)

W78-04069

MEMBRANE FILTRATION OF SSL (SPENT SULFITE LIQUOR) FOR RECOVERY OF BY-PRODUCTS AND POLLUTION CONTROL,
DDS RO Div. (Denmark). Dept. of Pulp and Paper. For primary bibliographic entry see Field 5D. W78-04074

PULP AND PAPER MANUFACTURE: ENERGY CONSERVATION AND POLLUTION PREVENTION,

Noyes Data Corp., Park Ridge, NJ.
For primary bibliographic entry see Field 5D. W78-04084

AN ANALYSIS OF BOD AND COD IN THE STONE GROUNDWOOD PROCESS,

Technische Univ. Darmstadt (West Germany). Inst. fuer Paper-fabrikation.
For primary bibliographic entry see Field 5A. W78-04089

IN-PLANT TECHNOLOGY FOR THE PREVENTION OF AIR AND WATER POLLUTION (ZAKLADOWE TECHNOLOGIE ZAPOBIEGANIA ZANIECZYSZCZANIU POWIETRZA I WODY),

IVL-Consulting Ltd., Goteborg (Sweden). For primary bibliographic entry see Field 5G. W78-04093

COMMERCIAL AND INSTITUTIONAL WATER USE IN PUERTO RICO,

Puerto Rico Univ., Mayaguez. School of Engineering.
For primary bibliographic entry see Field 6B. W78-04097

3F. Conservation In Agriculture

DRIP IRRIGATION OF SUGARCANE MEASURED BY HYDRAULIC LYSIMETERS, KUNIA, OAHU,
Hawaii Univ., Honolulu. Water Resources Research Center. P. C. Ekern.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 122. Price codes: A06 in paper copy, A01 in microfiche. Technical Report No. 109, June 1977. 99 p, 14 fig, 14 tab, 37 ref, 7 append. OWRT A-031-HI (1), 14-31-0001-3811, 14-31-0001-4011.

Descriptors: *Lysimeters, *Evapotranspiration, *Soil moisture, *Consumptive use (Water), *Deep percolation, Irrigation programs, Infiltration, Tensiometers, Drip irrigation, *Sugarcane, Measure-

ment, Water budget, *Oxisol, Molokai soil, Kunia, Oahu, *Hawaii.

The daily water budget of drip-irrigation sugarcane at Kunia, Oahu, was measured in large hydraulic load cell lysimeters. The 10-mo plant crop period was extrapolated to 109 cm (43 in.)/12-mo water use. Extrapolation from the full-canopied period (leaf area index 4) gave only 99 cm (39 in.)/12-mo of water use. The initial 12 mo of the second ratoon had 128 cm (50.5 in.) of evapotranspiration—a 2-yr cycle of water use would be 278 cm (109.5 in.) or 140 cm (55 in.)/12 mo. Drip irrigated cane used an average 79% of the 173 cm (70 in.) of annual class A surface pan evaporation or 70% of the evaporation from a pan elevated to 1.52 m (5 ft) or one kept at can canopy height. This lower ratio between cane use and pan evaporation would make water use 15% less from drip irrigated as compared to sprinkler irrigated fully canopied cane. The average portion of sunlight energy equivalent to cane evapotranspiration was 45%, but ranged from 25% immediately after planting to as great as 60% during periods of strong positive advection with full cane canopy. Further economies in water use with drip irrigation resulted from the much greater uniformity of distribution of water with drip as opposed to sprinkler irrigation. During rainy periods, percolation was not curtailed and evapotranspiration was as little as 20% of the applied rainfall and irrigation. However, during the dry summer months, evapotranspiration was essentially equal to the combined rainfall and drip irrigation. Salt rings formed at the perimeter of the 0.61-m (2-ft) diameter surface zone wetted around each submatic dripper. The maximum percolate rates through the 1.52-m Molokai Oxisol profile were 5 cm/day (2 in./day), even with water ponded on the surface. Essentially none of the 356.73 kg/ha (318 lb/acre) of nitrogen applied as fertilizer was removed in the deep percolate. Chloride content of the percolate which had increased from 150 mg/l to over 700 mg/l during the period of sprinkler irrigation underwent a parallel increase under drip irrigation after the initial flush from the heavy rainfall in January 1971. Silica levels of 65 mg/l in the irrigation water were reduced to 20 mg/l in the percolate. W78-03753

ARTIFICIAL-RECHARGE EXPERIMENTS NEAR LAKIN, WESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div., and Kansas Water Resources Board, Topeka.
For primary bibliographic entry see Field 4B. W78-03775

WATER SHORTAGE IN ISRAEL: LONG-RUN POLICY FOR THE FARM SECTOR,
New Mexico Univ., Albuquerque. Dept. of Economics.

M. Gisser, and S. Pohorelsky.
Water Resources Research, Vol 13, No 6, p 865-872, December 1977. 1 fig, 5 tab, 4 ref.

Descriptors: *Israel, *Water shortage, Agriculture, *Income loss, *Linear programming, *Estimating, *Water allocation (Policy), Water supply, Data, Farm sector, Water quota, Technological changes, Economic efficiency, Constraints, Regions, Mathematical models, Systems analysis.

In the year 1985, it is expected that Israel will suffer a significant deficit in its water balance; this country faces a situation of limited water supply and increasing demands. Since agriculture uses a large fraction of the available water, one potential policy is to reduce allocations of water to agriculture in order to permit the growth of its use in other sectors. A linear programming model is used to estimate the total loss income to agriculture from reduction in current allocations; these estimates are to be taken as guideline estimates only. Results show that a 10%, 20%, or 30% reduction in

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F—Conservation In Agriculture

water quotas will give rise to roughly a 6%, 12%, or 18% reduction in farm income if no technological change is assumed. If technological changes are supposed, then the reductions in agricultural income will be 1%, 7%, and 12%, respectively. Policy recommendations are given: (1) use the extension services to help farmers in the moshavim to switch from the moshav dairy farm to a large-scale water-efficient kibbutz-type farm; (2) provide the loans that would be needed for the above transformation; (3) to enhance intrasector efficiency, encourage farmers to trade in water quotas on the margin, and this would work only if the practice were to (4) charge the real marginal cost on the margin (the margin should cover 15%-21%). (Bell-Cornell) W78-03990

CONTROL OF NONPOINT WATER POLLUTION FROM AGRICULTURE: SOME CONCEPTS,
Agricultural Research Service, Chickasha, OK. Southern Great Plains Watershed Research Center.
For primary bibliographic entry see Field 5G.
W78-04200

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

WATER-RESOURCES INVESTIGATIONS IN NORTH DAKOTA, 1976.
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03764

WATER-RESOURCES INVESTIGATIONS IN ARIZONA, 1977.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03765

SEEPAGE TESTS ON NO NAME CREEK, COLVILLE INDIAN RESERVATION, WASHINGTON, MAY 12-13, 1977.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W78-03777

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1976.
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03780

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 2. EASTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03781

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 1. WESTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03782

DESIGN OF WATER RESOURCES PROJECTS WITH INADEQUATE DATA, VOLUME 2.
International Association of Scientific Hydrology, Gentbrugge (Belgium). Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), 1974. 696 p.

Descriptors: *Water resources development, *Conferences, *Methodology, *Design criteria, *Economics, *Hydrologic aspects, Design data, Rainfall-runoff relationships, Evaluation, Evaporation, Water resources, Project planning, Projects, Optimization, Water quality, Management, Groundwater, Hydrology, Precipitation(Atmospheric), Sedimentation, Reservoir siltation, Floods, Flood frequency, Unit hydrographs, *Inadequate data, Analytical techniques, Design flood, Suspended load, Watersheds(Basins), Discharge(Water), Runoff, Snowmelt, Foreign countries, Foreign research, Hydrologic data.

This symposium focused on: (1) the methodology for hydrologic studies for water resources projects with inadequate data; (2) current practices for the assessment of design parameters in different countries; and (3) relation between project economics and hydrological data. (See W78-03784 thru W78-03813) (Humphreys-ISWS) W78-03783

WATER RESOURCES PROJECTS IN NIGERIA AND THE HYDROLOGICAL DATA EMPLOYED IN THEIR PLANNING AND DEVELOPMENT,
Ife Univ. (Nigeria). Dept. of Agricultural Engineering.

A. A. Abiodun.
In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 21-32, 1974. 3 fig, 9 ref.

Descriptors: *Water resources development, *Projects, *Rainfall-runoff relationships, *Africa, Planning, Water supply, Flood control, Lakes, Equations, Groundwater, Surface waters, Foreign countries, Foreign research, *Nigeria, *Lake Chad Basin(Nigeria).

The need for adequate water supply to meet the demands of Nigeria's growing population is well known. However, the technical adviser is seriously handicapped in planning efforts by the lack of sufficient information. Within the past decade, a number of water resources schemes have been developed, and in general, these schemes have been planned with very limited hydrological data that were often extended through the application of statistical techniques to provide rational design parameters. In others, 'educated guess' technique was substituted. The net result of such methods has been the failure of many water supply schemes to meet demands, especially during the dry season, and the location of unproductive boreholes which had to be abandoned. These schemes were reviewed, and the hydrologic information employed in designing them was appraised. This study showed that Nigeria must intensify efforts to provide extensive basic data on surface and groundwater resources if costly mistakes are to be avoided in the future. (See also W78-03783) (Humphreys-ISWS) W78-03788

AN EXAMPLE OF REGIONAL CO-OPERATION FOR IMPROVING THE HYDROLOGICAL AND METEOROLOGICAL INFORMATION,
World Meteorological Organization, Managua (Nicaragua). Central American Hydrometeorological Project.
For primary bibliographic entry see Field 7A.
W78-03785

METHODOLOGY EXISTING FOR ESTIMATING FREE SURFACE WATER EVAPORATION,
For primary bibliographic entry see Field 2D.
W78-03786

GEOHYDROLOGICAL STUDIES IN SMALL AREAS WITHOUT SYSTEMATIC DATA,
For primary bibliographic entry see Field 4B.
W78-03787

METHODS OF ANALYSING DEFICIENT DISCHARGE DATA IN ARID AND SEMI-ARID ZONES FOR THE DESIGN OF SURFACE WATER UTILIZATION,
Tahal Water Planning for Israel Ltd., Tel Aviv. J. S. Dalinsky.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 95-119, 1974. 6 fig, 3 ref, 2 append.

Descriptors: *Water resources development, *Planning, *Streamflow, *Hydrograph analysis, Annual flood, Hydrographs, Frequency, Surface waters, Reservoir storage, Flow duration, Analytical techniques, Arid climates, Semiarid climates, Hydrologic aspects, Discharge(Water), Hydrology, Sediment discharge, Diversion, Foreign research, Foreign countries, *Israel, Inadequate data.

This paper surveyed various methods of analysing stream flow: frequency of annual volumes, discharge-volume relationship with horizontal, vertical and double hydrograph cutting, and calculation of the storage volumes available as a function of reservoir capacity. Application of the methods can generate data for the design of surface water utilization schemes when flow records are available for only a few years. The understanding and application of the general design aspects, even if only qualitative, enables the planning engineer to reduce his basic hydrological requirements to less than 10 years duration. It was proposed that applied hydrological research be directed towards evaluation of a number of important hydrological design parameters on a regional basis to enable nondimensional curves to be established. (See also W78-03783) (Humphreys-ISWS) W78-03788

APPLICATION OF COUTAGNE'S AND TURC FORMULAS TO THE SOUTHERN MOZAMBIQUE RIVERS,
E. E. D'Oliveira, and J. J. Mimoso.
In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 121-140, 1974. 2 fig, 6 tab.

Descriptors: *Rainfall-runoff relationships, *Watersheds(Basins), *Africa, Estimating, Hydrologic aspects, Hydrology, Rainfall, Air temperature, Analytical techniques, Humidity, Evaporation, Runoff, Streamflow, Discharge(Water), Rivers, Hydrologic data, Sediment discharge, Foreign research, Foreign countries, *Mozambique, Inadequate data.

One of the base elements necessary for the planning of an economical development program is the knowledge of the value and distribution of hydrological resources. In Mozambique, registration of the water resources has been facing great difficulty because of the lack of observations of hydrologic phenomena, namely the runoff and flow discharges of rivers and water-sources. Coutagne's and Turc general rules, which require that rainfall and temperature be known, were applied to obtain approximate annual mean runoff values for several rivers in Southern Mozambique where

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WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

few gauging stations exist. It was concluded from the results obtained that these rules give annual mean runoff values with deviations of less than 10%. (See also W78-03783) (Humphreys-ISWS) W78-03789

MAPAI HYDROLOGICAL STUDY (LIMPOPO'S RIVER),

E. E. D'Oliveira, and J. J. Mimoso.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 141-154, 1974. 3 fig, 1 tab.

Descriptors: *Watersheds(Basins), *Africa, *Runoff, *Estimating, Water resources, Streamflow, Climates, Hydrologic aspects, Floods, Hydrologic data, Analytical techniques, Discharge(Water), Rainfall, Hydrographs, Annual, *Mozambique, *Limpopo River(Mozambique), Inadequate data.

The Limpopo is one of the most important rivers of South Africa and Mozambique, and it is contained in the lower part of the great drainage area, which includes more than half of the Transvaal and a considerable part of South Rhodesia. Flow discharge observations are not available for the future location of Mapai Dam, and therefore estimates of runoff were made. The analytical techniques were indicated and results were summarized. (See also W78-03783) (Humphreys-ISWS) W78-03790

RELATION OF HYDROLOGICAL PROGRAMS OF THE CENTER OF HYDROGRAPHIC STUDIES FOR COMPLETE STUDIES OF HYDRAULIC RESOURCES WITH INSUFFICIENT DATA,

For primary bibliographic entry see Field 2A.

W78-03791

COMPUTATION OF RESERVOIRS SEDIMENTATION,

Gosudarstvennyi Gidrologicheskii Inst., Lenin-

grad (USSR).

For primary bibliographic entry see Field 2J.

W78-03792

CALCULATION OF RUNOFF IN IRAQ,

R. K. Klique, and M. E. Sachob.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 207-215, 1974.

Descriptors: *Runoff, *Equations, *Streamflow, *Foreign countries, Variability, Floods, Discharge(Water), Annual, Seasonal, Monthly, Wet seasons, Dry seasons, Low flow, Average flow, Foreign research, *Iraq, Inadequate data.

The general characteristic of runoff and its distribution in Iraq were given. Results of correlation analysis studies of runoff with elevation, river basin area, flood duration period, and low-water period were given. It was concluded that the given relationships of different flow characteristics, despite their approximate nature and need for more precision, permit the evaluation of a number of flow parameters for insufficiently studied regions of Iraq. (See also W78-03783) (Humphreys-ISWS) W78-03793

DETERMINATION OF EVAPORATION IN CASE OF THE ABSENCE OR INADEQUACY OF DATA,

Gosudarstvennyi Gidrologicheskii Inst., Lenin-

grad (USSR).

For primary bibliographic entry see Field 2D.

W78-03794

OBJECTIVE CRITERIA TO DECLARE A SERIES OF DATA SUFFICIENT FOR TECHNICAL PURPOSES,

For primary bibliographic entry see Field 2A.

W78-03795

SOME CRITERIA USED IN HYDROLOGIC STUDIES WITH INADEQUATE DATA,

For primary bibliographic entry see Field 2A.

W78-03796

DETERMINATION OF HYDROLOGICAL CHARACTERISTICS IN POINTS WITHOUT DIRECT HYDROMETRIC DATA,

World Meteorological Organization, Bogota (Columbia); and United Nations Development Program, Bogota (Columbia).

S. Stanescu.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 265-285, 1974. 18 fig, 7 ref.

Descriptors: *Surveys, Programs, *Water resources, *South America, *Hydrologic data, Estimation, Surface waters, Mapping, Water quality, Runoff, Rivers, On-site investigations, Discharge(Water), Sediment discharge, Foreign countries, Foreign research, *Colombia, Inadequate data.

In Columbia, hydrological information is very scarce. Consequently, no direct hydrometric data are available for most of the sites of projected hydrotechnical works and exploitation of water. Therefore, one must generally apply methods of generalization, transfer of direct information from observed points to points of interest, and indirect estimation of the hydrological characteristics. In relation with this, there are several proceedings of indirect determination of mean, maximum, and minimum runoff, as well as of other characteristics of the hydrological regime which are applied to the concrete conditions of Columbia. The examples, included to illustrate the application of the methods pointed out, were selected from complex hydrological studies, elaborated or in the process of elaboration, within the frame of the activities of interpretation and hydrological calculations worked out in the Colombian Service of Meteorology and Hydrology. (See also W78-03783) (Humphreys-ISWS) W78-03800

NEW MODELS OF FREQUENCY LAW OF RUNOFF STARTING FROM PRECIPITATIONS,

I.T.O.P. Coll., Madrid (Spain).

J. R. Temez.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 287-300, 1974. 9 fig.

Descriptors: *Rainfall-runoff relationships, *Watersheds(Basins), *Runoff forecasting, Water balance, Evapotranspiration, Rainfall, Frequency analysis, Frequency, Correlation analysis, Runoff, Estimating, Floods, Discharge(Water), Foreign research, Foreign countries, *Spain, Inadequate data.

The frequency law of annual precipitation was used to determine the frequency law of the annual runoff relationship applicable to drainage basins which do not have discharge data. The procedure included the following steps: (1) calculate frequency law of precipitation; (2) determine the potential evapotranspiration value of the basin from evaporation data or charts; (3) estimate the minimum effective precipitation; and (4) apply proposed equation to transform frequency law of precipitation to frequency law of runoff. The proposed method was developed for rainy areas

and has not been studied for adaptation to snowfall. (See also W78-03783) (Humphreys-ISWS) W78-03798

DESIGNING PROJECTS FOR THE DEVELOPMENT OF GROUND WATER RESOURCES IN THE ALLUVIAL PLAINS OF NORTHERN INDIA ON THE BASIS OF INADEQUATE DATA,

For primary bibliographic entry see Field 4B.

W78-03799

ESTIMATION OF FLOODS BY MEANS OF THEIR SILT LOADS,

M. B. Girona.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 439-457, 1974.

Descriptors: *Floods, *Estimating, *Europe, *Sediment discharge, Silts, Sediments, Watersheds(Basins), On-site investigations, Streambeds, Bed load, Flood discharge, Alluvial channels, Analysis, Analytical techniques, Foreign research, Foreign countries, *Spain, Inadequate data.

An empirical and experimental formula of very simple structure was studied to obtain the flows of maximum floods in relation to the sediment loads that the floods produce, depending only on the maximum size of particles of the channel. This formula can be useful for studying the behavior of the river bed, alluvial volume, and so on. Verification tests indicated that maximum error is 13% when using the proposed formula for estimating the historic flood discharge. (See also W78-03783) (Humphreys-ISWS) W78-03800

ESTIMATION OF DESIGN FLOODS AND THE PROBLEM OF EQUALIZING THE PROBABILITY OF RAINFALL AND RUNOFF,

Institute of Hydrology, Wallingford (England).

M. A. Beran.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 459-471, 1974. 4 fig, 1 tab, 6 ref, 1 append.

Descriptors: *Design flood, *Estimating, *Statistical methods, *Hydrologic aspects, Floods, Simulation analysis, Hydrographs, Runoff, Rainfall, Frequency, Analytical techniques, Time, Frequency curves, Probability, Annual peak discharge, Rainfall-runoff relationships, Flood recurrence interval, Base flow, Analysis, Stochastic processes, Inadequate data.

Where data on river discharge are scarce, it is a common engineering design practice to concoct a design flood with the aid of rainfall depth-duration-frequency information and a catchment response model. Two major weaknesses of this approach are: (1) the problem of the sensitivity of the design of legitimate changes in the design assumptions, and (2) the uncertainty of preserving the nominal rainfall return period in the design flood. A solution to these problems was proposed which makes use of a computer simulation investigating the sensitivity of flood magnitude to variations in return period, storm duration, temporal rainfall intensity pattern, infiltration loss rate, base flow, and unit hydrograph shape. An extension to the sensitivity analysis allows an estimate to be made of any quantile of the distribution of flood magnitude based on sampling across all causative rainfall and antecedent conditions. While attention was concentrated on peak discharge as the measure of flooding, it should be emphasized that the technique is suited to more complex design

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control Of Water On The Surface

criteria. The hydrograph may be treated as an inflow and routed through the scheme, and so the actual design criteria of interest may be calculated. (See also W78-03783) (Humphreys-ISWS) W78-03801

SYNTHETIC UNIT HYDROGRAPH TECHNIQUE FOR THE DESIGN OF FLOOD ALLEVIATION WORKS IN URBAN AREAS,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.

M. J. Hall.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 485-500, 1974. 4 fig, 2 tab, 15 ref.

Descriptors: *Hydrograph analysis, *Unit hydrographs, *Cities, *Urban hydrology, Floods, Watersheds(Basins), Analytical techniques, Rainfall, Flood control, Runoff, Base flow, Time lag, Foreign research, Foreign countries, *England, Inadequate data.

The development of rural land for urban, suburban, or industrial purposes can alter radically the flow regime of the catchment area within which such changes take place. The volume of surface runoff tends to increase, the lag time of the flood hydrograph to decrease, and the peak rate of flow to increase. These changes should be anticipated in the design of flood alleviation works for catchment areas undergoing urbanization. But in general, little quantitative information is available on the magnitude of the effect at different stages of urban development. If flow records are available from several catchment areas, each of which has reached a different stage of urban development, the finiteperiod unit hydrographs derived from these data can be used as an index to the influence of urbanization. The application of a synthetic unit hydrograph technique to flow records from both urban and rural catchment areas within the headwaters of the River Mole near Crawley, United Kingdom, has confirmed the feasibility of the approach but has shown that more thought is necessary in choosing catchment characteristics which reflect the character of the urban development. (See also W78-03783) (Humphreys-ISWS) W78-03802

A DIMENSIONLESS UNITGRAPH FOR HONG KONG,

Southampton Univ. (England). Dept. of Civil Engineering.

P. R. Hellinwell and T. Y. Chen.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 501-516, 1974. 6 fig, 2 tab, 7 ref.

Descriptors: *Unit hydrographs, *Hydrograph analysis, *Watersheds(Basins), *Cities, Discharge(Water), Runoff forecasting, Measurement, Time lag, Streamflow, Forecasting, Runoff, Foreign countries, Foreign research, *Hong Kong, Inadequate data.

The large number of individual catchments in Hong Kong makes it impractical to measure streamflows on all but a small proportion of streams. Rainfall characteristics and topography are similar over much of the area. Using data for several storms at each of the 7 stream gauging stations, a mean dimensionless unitgraph was derived. Basin lag was used in the conversion of both time and discharge scales. For ungauged catchments, basin lag can be estimated either as a simple function of catchment size or as shape and slope. This work was based on records collected in 1964 and 1965. (See also W78-03783) (Humphreys-ISWS) W78-03803

STUDY OF MAXIMUM FLOODS IN SMALL BASINS OF TORRENTIAL TYPE,

R. Heras, and A. Lara.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 517-539, 1974. 16 fig, 4 tab.

Descriptors: *Small watersheds, *Hydrograph analysis, *Floods, *Methodology, Meteorology, Analytical techniques, Forecasting, Runoff, Geology, Foreign countries, Foreign research, Geology, Watersheds(Basins), *Grand Canary Island, Inadequate data.

The methodology of study was summarized for small basins of torrential character and was applied to the Tirajana Gully of the Gran Canaria Island, considering the geological and geomorphological conditions of the basin and also the principal physical characteristics of the gully. Considering the physical characteristics and a complete statistical study of intensities, the hydrograph was established for different hypotheses, and the type of hydrograph was studied in relation to the duration-intensity-frequency curves of maximum precipitation in 24 hours. (See also W78-03783) (Humphreys-ISWS) W78-03804

FLOOD ESTIMATION BY DETERMINATION OF REGIONAL PARAMETERS FROM LIMITED DATA,

P. H. Herbst, S. Van Biljon, J. P. J. Olivier, and J. M. Hall.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 541-552, 1974. 3 fig, 2 tab, 13 ref.

Descriptors: *Floods, *Forecasting, *Peak discharge, *Statistical methods, *Africa, Hydrograph analysis, Watersheds(Basins), Regression analysis, Statistical models, Flood frequency, Runoff, Annual peak discharge, Hydrographs, Annual flood, Methodology, Estimating, Flow duration, Foreign countries, Foreign research, *South Africa, Inadequate data.

A regionalized study of maximum annual flows of different short durations (including peaks) was carried out. In view of the limited length of record available at most of the gauging stations in the region, an attempt was made to develop a technique to strengthen the data available at any particular point of interest by using all pertinent flow data in the region. Having chosen the extremal distribution best suited to the region, the moments of the sample (after adjustment) were correlated with various catchment characteristics. This allowed estimation of flood magnitude frequency curves, at any site of interest within the region with associated confidence bands. Such frequency curves were determined for various suitable time intervals which then allows the synthesis of characteristic flow hydrographs, with a specific probability of occurrence attached to each, along with associated envelopes corresponding to specific confidence limits. Comparison with hydrographs derived from rainfall input depths with specified probabilities, subtracting losses and then using unitgraph methods, lead to the conclusion that a better relation between probability of occurrence of a specific hydrograph, and its magnitude, usually can be obtained by direct statistical methods than by more indirect deterministic techniques. (See also W78-03783) (Humphreys-ISWS) W78-03805

PRACTICES OF DESIGN FLOOD FREQUENCY FOR SMALL WATERSHEDS IN THAILAND,

Royal Irrigation Dept., Bangkok (Thailand).

Hydrology Div.

D. Jaraswathana, and S. Pinkayan.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 553-556, 1974. 2 ref.

Descriptors: *Design, *Small watersheds, *Hydrologic aspects, *Water resources, Flood frequency, Rainfall-runoff relationships, Hydrographs, Design storm, Frequency, Rational formula, Watersheds(Basins), Foreign countries, *Thailand, Inadequate data.

It is true that adequate hydrologic data do not exist and that development of water resources projects cannot be kept waiting until data are made available. Thailand shares these conditions with the other developing countries. The hydrologic data conditions in Thailand can be categorized as follows: (1) No data are available in the catchment area; (2) some data are available within neighboring areas; (3) some data with short period of record do exist; and (4) considerable data are low with low reliability and accuracy available. The purpose of this paper was to present the general practices of hydrologic analyses in Thailand, particularly on design flood frequency in small watersheds. The method, which is the common practice for assessing design floods, was based on the concept of rational formula, the unit distribution graph, and the design storm obtained by the conventional procedures of frequency analysis. It was concluded that new concepts and statistical techniques which give more reliability are needed for the design of small water resources projects in Thailand. (See also W78-03783) (Humphreys-ISWS) W78-03806

DESIGN DISCHARGE DERIVED FROM DESIGN RAINFALL,

Public Works Research Inst., Tokyo (Japan).

For primary bibliographic entry see Field 2A.

W78-03807

THE USE OF CENSORED DATA IN ESTIMATING T-YEAR FLOODS,

Institute of Hydrology, Wallingford (England).

M. N. Leese.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 563-575, 1974. 3 tab, 8 ref.

Descriptors: *Flood forecasting, *Statistical methods, *Sampling, *Floods, Forecasting, Hydrologic data, Flood recurrence interval, Probability, Data processing, Annual peak discharge, Peak discharge, Discharge(Water), Annual flood, Statistical models, Time series analysis, Analytical techniques, Watersheds(Basins), Foreign countries, Foreign research, *United Kingdom, Inadequate data.

Types of incomplete data to be found in connection with flood series were described, and it was shown how samples containing such data may be used to estimate the parameters of a distribution describing annual maximum flows. Formulas for the standard errors of the resulting estimates also were given. Examples were taken from a river for which censored data exist. Preparatory data standardization was described, and the parameters estimated using this data were compared with the data estimated using the complete sample only. The marginal value of using censored data in this context was assessed by means of the subsequent reduction in the standard errors of the estimates of T-year floods for various values of T, and this was related to the effort required to collect and standardize the data. (See also W78-03783) (Humphreys-ISWS) W78-03808

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WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

ASSESSMENT OF DESIGN FLOODS IN BRAZIL

P. Poggi Pereira.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 577-587, 1974. 1 fig, 1 tab, 7 ref.

Descriptors: *Design flood, *Methodology, *Design criteria, *Watersheds(Basins), Discharge(Water), Floods, Runoff, Rational formula, Flood recurrence interval, Runoff coefficient, Rural areas, Cities, Design flow, Rainfall, Probable maximum precipitation, Foreign countries, *Brazil, Inadequate data.

The techniques utilized by the Departamento Nacional de Obras de Saneamiento for computing the characteristics of flood to be used for designing works against inundations were described. Very seldom trustworthy river flood discharge measurements are obtained. In most cases, design flood discharges are estimated with a basis on topographic data which can be gathered quickly. Until thirty years ago the contributing basin area was multiplied by a standard unit discharge in order to get the design flood discharge. Later on, the rational method was adopted, mainly for designing small canals. This system was improved considerably by the execution of a statistical study of heavy rains observed in the country. The choice of the height of some dikes was based on the high water levels attained during ancient floods observed and still remembered by local people. It has been found necessary to perform more elaborate and time-consuming hydrological observations and studies for designing dams. The use of mathematical models is still incipient but promising. Design floods of different standard periods of recurrence are adopted according to the type of the work, the size of the river, and the utilization given to the area to be protected. (See also W78-03783) (Humphreys-ISWS)

W78-03809

A METHOD FOR THE PREDICTION OF WASHLOAD IN CERTAIN SMALL WATERSHEDS

For primary bibliographic entry see Field 4D.

W78-03810

METHODS FOR THE ESTIMATION OF MAXIMUM DISCHARGES OF SNOW MELT AND RAINFALL WATER WITH INADEQUATE OBSERVATIONAL DATA

Gosudarstvennyi Gidrologicheski Inst., Leningrad (USSR).

For primary bibliographic entry see Field 2E.

W78-03811

COMPUTATION OF PROBABILISTIC VALUES OF LOW FLOW FOR UNGAUGED RIVERS

Gosudarstvennyi Gidrologicheski Inst., Leningrad (USSR).

A. M. Vladimirov, and A. I. Chebotarev.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 625-633, 1974. 6 ref.

Descriptors: *Low flow, *Forecasting, *Streamflow, Rivers, Base flow, Methodology, Equations, Seasonal, Monthly, Discharge(Water), Low-flow frequency, Design flow, Design flow, Design criteria, Foreign countries, *USSR, Inadequate data.

The main characteristics of low flow (minimum daily, monthly, and seasonal flows) were investigated. The presented computation methods are based on a combined use of geographical interpolation and probability analysis and the consideration of the main factors affecting the volume

and regime of low flow. Principal characteristics of low flow for medium-size rivers are determined by maps of flow isolines, and those characteristic for small rivers are determined by regional empirical correlation. Design flow is established by means of transition coefficients. The principal computation methods discussed were developed for USSR rivers. (See also W78-03783) (Humphreys-ISWS)

W78-03812

A STUDY OF MAXIMUM FLOOD DISCHARGE FORMULAS

Seoul National Univ. (Republic of Korea). Dept. of Civil Engineering.

T. S. Won.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 635-647, 1974, 17 fig, 4 tab, 1 ref.

Descriptors: *Maximum probable flood, *Flood discharge, *Flood forecasting, *Asia, *Watersheds(Basins), Design flood, Flood routing, Rainfall-runoff relationships, Equations, Analytical techniques, Methodology, Stochastic processes, Statistical methods, Rainfall, Rainfall intensity, Peak discharge, Time of concentration, Hydrology, Foreign countries, Foreign research, *Korea, *Manchuria, Inadequate data.

This paper described a new formula for the calculation of approaching velocity of rain water and a number of new formulas for the estimation of maximum flood discharge. Many empirical formulas exist which have limited application. However, in devising his formulas, the author derived theoretically the form of the basic maximum discharge formula for the case of rivers with no tributaries and determined stochastically the value of the coefficients using the records of observed measurements. The author derived theoretically formulas for the case of rivers with tributaries to fit in the actual localities of the site under consideration. The formulas should be widely applicable for rivers or sewer nets and also for any regions or countries. The author's formulas may be used not only for estimating the design flood but also in flood routing. The author's formulas may be used not only for estimating the design flood but also in flood routing. The author believes that his formulas would be very helpful in the planning of water resources development projects, especially for those with inadequate data. (See also W78-03783) (Humphreys-ISWS)

W78-03813

SOME ASPECTS OF THE PERSISTENCE AND FATE OF ACROLEIN HERBICIDE IN WATER

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.

For primary bibliographic entry see Field 5B.

W78-03817

LAKES AND PONDS

Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture.

For primary bibliographic entry see Field 6B.

W78-03842

AN APPLICATION OF THE INTERREGIONAL I/O MODEL FOR THE STUDY OF THE IMPACT OF THE MCCLELLAN-KERR ARKANSAS RIVER MULTIPLE PURPOSE PROJECT

Catholic Univ. of America, Washington, DC. Inst. of Social and Behavioral Research.

U. Kim, C. Park, and S. K. Kwak.

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-040 216, Price codes: A10 in paper copy, A01 in

microfiche. Prepared for Army Engineer Institute for Water Resources, Fort Belvoir, VA, March 1977, 209 p, 19 tab, 4 append. DACW31-74-C-0047.

Descriptors: *Input-output analysis, *Mathematical models, *Evaluation, *Project planning, *Economic impact, Economics, Construction costs, Transportation, Flood control, Water supply, Electric power, Recreation, Sediment control, *McClellan-Kerr Arkansas River Navigation System, *Interregional input-output model, *Impact study.

This study applies the Interregional Input-Output Model of the United States to the assessment of the impacts of constructing the McClellan-Kerr project. The report describes the model used, the assumptions adopted, the procedures for adapting the national Input-Output Model to project evaluation, and the programs and data summaries for all major steps of analysis. The model is operational on Corps of Engineers computer equipment and available for adaptation to other project studies with relatively modest investment. The gross direct and indirect construction impact of the project was estimated by the I/O Model to be \$6.4 billion in output and \$2.1 billion in household income in 1963 dollars. Of this amount, 35.8 percent of the output and 52 percent of the income are estimated to be shared by the project region. This assessment is based on short term construction impacts and does not represent net increments of national income. Other more enduring benefits and costs will be obtained through the functional outputs of the McClellan-Kerr Arkansas River Navigation System. These outputs include transportation, flood control, water supply, electric power, sediment control and channel stabilization, and the enhancement of recreation, fish, and wildlife. The report is one of a series examining the impacts of the McClellan-Kerr Arkansas River Navigation System. (Nessa-NC)

W78-03899

FLOOD PLAIN INFORMATION: PAMUNKEY RIVER, HANOVER COUNTY, VIRGINIA

Army Engineer District, Norfolk, VA.

Prepared for Hanover County, VA, February 1975, 25 p, 6 fig, 25 plates, 6 tab.

Descriptors: *Virginia, *Flood profiles, *Flood data, *Peak discharge, Floods, Indirect flood measurement, Flood forecasting, Historic floods, Flood stages, Flow duration, Stage-discharge relations, Flood damage, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, Control structure, *Pamunkey River(VA), Hanover County(VA), Intermediate Regional Flood.

The study area includes the main stream and flood plain on either side of the Pamunkey River in New Hanover County, Virginia. The flood plain is undeveloped and mostly wooded. The projected county population growth rate of 4.5 percent will generate increasing land development pressures on the flood plain. Flood data were obtained from topographic maps, field studies, precipitation records and U.S. Geological Survey stream gage data. Flooding may occur at any time of year and results from heavy general rainfall or intense local thunderstorms. The worst known flood occurred in August 1928. On this date, flood waters are estimated to have crested 32.6 feet above flood stage. In another flood in August 1969, the flood waters crested at 31.1 feet above flood stage, discharging 40,300 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood is expected to crest 17.2 feet above flood stage and to discharge 42,000 cfs, while the Standard Project Flood will crest 21.7 feet above flood stage and will discharge 63,000 cfs. These floods would affect some farmland, roads, and utilities. Considerable damage to these facilities is anticipated. The data contained in this report are intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)

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Group 4A—Control Of Water On The Surface

W78-03902

FLOOD PLAIN INFORMATION: ALLEGHENY RIVER, ARMSTRONG COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.

Prepared for Armstrong County Planning Commission, PA, December 1973, 47 p, 37 fig, 19 plates, 8 tab.

Descriptors: *Pennsylvania, *Historic floods, *Flood data, *Peak discharge, Floods, Flood flow, Indirect flood measurement, Streamflow forecasting, Flood profiles, Storms, Flood stages, Flow duration, Stage-discharge relations, Flood plains, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Control structures, Floodwalls, Dams, Reservoirs, Standard Project Flood, Armstrong County(PA), *Allegheny River(PA), Freeport(PA), Ford City(PA), Kittanning(PA), Parker(PA), Intermediate Regional Flood.

The study area involves the Allegheny River and its flood plain in Armstrong County, Pennsylvania. Included are the major communities of Freeport, Ford City, Kittanning and Parker. The flood plain is largely developed with residential, commercial, and industrial land uses. Flood data were obtained from topographic maps, field studies, historical sources, and stream gage records. The main flood season occurs from December through April and results from heavy rains and snowmelt. Intense thunderstorms may cause severe floods at other times. There are 9 upstream flood control dams and reservoirs that act to reduce flood levels in the Allegheny River within Armstrong County by 4 to 10 feet. The worst flood recorded at Lock and Dam 7 occurred on March 26, 1913, discharging 270,000 cubic feet per second (cfs) and cresting at 802.0 feet mean sea level (msl). Another large flood in June 1972 discharged 189,300 cfs at the same location, cresting at 796.8 feet msl. At the same location, the Intermediate Regional Flood (IRF) would discharge 215,000 cfs and would crest at 798.2 feet msl, while the Standard Project Flood would discharge 261,000 cfs and would crest at 800.6 feet msl. The 1913 flood elevation would have been lower if present structural flood controls had been in place. This report is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)

W78-03903

FLOOD PLAIN INFORMATION: ALLEGHENY RIVER, NEW KENSINGTON, ARNOLD, LOWER BURRELL AND ALLEGHENY TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.

Prepared for Westmoreland County, PA and Pennsylvania Department of Environmental Resources, June 1973, 26 p, 6 fig, 8 plates, 6 tab.

Descriptors: *Pennsylvania, *Flood forecasting, *Flood profiles, *Historic floods, *Flood data, Floods, Indirect flood measurement, Storms, Flood frequency, Flood stages, Peak discharge, Flow duration, Flow characteristics, Stage-discharge relations, Flood damage, Rivers, Flood plains, Standard Project Flood, Flood protection, Warning systems, Land use, Planning, Control structures, Floodwalls, Dams, Reservoirs, *Allegheny River(PA), Westmoreland County(PA), New Kensington(PA), Arnold(PA), Lower Burrell(PA), Allegheny Township(PA), Intermediate Regional Flood.

The study area involves the Allegheny River and its flood plain in Westmoreland County, Pennsylvania, including the Town of New Kensington, the Borough of Arnold, and the Townships of Lower Burrell and Allegheny. There are no developments in the flood plain that would be significantly affected by flooding due to structural flood control

measures and the naturally high, steep river banks. There are 8 upstream flood control dams and reservoirs, with one more under construction. Flood data were obtained from topographic maps, historical sources, field studies, and stream gage records. The main flood season is December through April and results from heavy rain and snowmelt. Intense local thunderstorms may cause flooding at other times. The worst flood of record occurred on March 18, 1936, cresting at 770.7 feet mean sea level (msl) and discharging 360,500 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood (IRF) would crest at 763.4 feet msl and would discharge 233,000 cfs, while the Standard Project Flood (SPF) would crest at 766.7 feet msl, and would discharge 290,000 cfs. This report is intended for use in making land use planning and management decisions regarding flood plain utilization. (Nessa-NC)

FLOOD PLAIN INFORMATION: OHIO, ALLEGHENY, MONONGAHELA AND YOUNGHOOGHENY RIVER, ALLEGHENY COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.

Prepared for Allegheny County Board of Commissioners, PA, March 1973, 62 p, 24 fig, 36 plates, 16 tab.

Descriptors: *Pennsylvania, *Streamflow forecasting, *Flood forecasting, *Flood profiles, Historic floods, *Flood data, Floods, Indirect flood measurement, Storms, Flood frequency, Flood stages, Peak discharge, Flow duration, Stage-discharge relations, Rivers, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Control structures, Dams, Reservoirs, *Allegheny River(PA), *Ohio River(PA), *Monongahela River(PA), *Youghiogheny River(PA), Allegheny County(PA), Pittsburgh(PA), Intermediate Regional Flood.

The study area involves the portions of Allegheny County, Pennsylvania, including the City of Pittsburgh, that are subject to flooding from the Ohio, Allegheny, Monongahela and Youghiogheny Rivers. Flood plain developments in urban areas are industrial, commercial, and residential, comprising the supporting components for the total urban industrial complex. Developable lands are not available; however, urban areas prime for redevelopment are continually identified and may fall within the flood plain. Flood data were obtained from topographic maps, field studies, historical sources, and stream gage records. There are 10 upstream flood control dams and reservoirs that help reduce flood levels in Pittsburgh. The main flood season occurs from December through April, resulting from heavy rain and snowmelt. Intense rainfall may cause flooding at other times. The worst flood recorded on the Ohio River at Pittsburgh occurred on March 18, 1936, cresting at 740.2 feet mean sea level (msl) and discharging 557,000 cubic feet per second (cfs). This flood is used in lieu of a Standard Project Flood determination. At the same location, the Intermediate Regional Flood would crest at 729.5 feet msl and would discharge 375,000 cfs. Historic and future flood profiles are provided for the entire study area. This study is intended for use in making land use planning and management decisions regarding flood plain utilization. (Nessa-NC)

W78-03905

FLOOD PLAIN INFORMATION: CONEMAUGH AND LITTLE CONEMAUGH RIVERS, STONY AND BENS CREEKS, CITY OF JOHNSTOWN AND VICINITY, CAMBRIA AND SOMERSET COUNTIES, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.

Prepared for Counties of Cambria and Somerset, PA, December 1974, 54 p, 49 fig, 13 plates, 10 tab.

Descriptors: *Pennsylvania, *Indirect flood measurement, *Flood forecasting, *Flood profiles, *Flood data, *Peak discharge, Floods, Flood flow, Storms, Historic floods, Flood stages, Stage-discharge relations, Rivers, Flood plains, Flood protection, Non-structural alternatives, Land use, Planning, Control structures, Standard Project Flood, *Conemaugh River(PA), *Little Conemaugh River(PA), Johnstown(PA), Cambria County(PA), Somerset County(PA), Stony Creek(PA), Bens Creek(PA), Intermediate Regional Flood.

The study area involves the Conemaugh River and its tributaries in the vicinity of the City of Johnstown in Cambria and Somerset Counties, Pennsylvania. Most of the study area is densely developed with residential, commercial and industrial land uses. Bens Creek, a tributary to the Conemaugh in the study area, is sparsely developed. Flood data were obtained from topographic maps, field studies, historical sources, and intermittent and permanent stream gage records. The main flood season is December through April, and results from rainfall combined with snowmelt. Intense local thunderstorms may cause flooding at other times. The worst known flood was the famous Johnstown flood of May 31, 1889, which resulted from a collapsed dam. The worst flood without unnatural augmentation occurred on March 18, 1936, cresting at 22.8 feet above flood stage and discharging 90,000 cubic feet per second (cfs). Structural flood prevention measures completed in November 1943 protect much of the developed area from floods as large as the Intermediate Regional Flood (IRF). At stream mile 52.06 on the Conemaugh River, the IRF will crest 28.25 feet above flood stage and discharge 83,000 cfs while the Standard Project Flood (SPF) will crest 35.5 feet above flood stage and discharge 128,000 cfs. The IRF is larger than the 1936 flood. There are 13 bridges in the study area that are obstructive to major flood flows; 9 of these are obstructive to the IRF. This report will facilitate land use planning and management decisions. (Nessa-NC)

W78-03906

FLOOD PLAIN INFORMATION: PETERS CREEK, JEFFERSON BOROUGH, ALLEGHENY COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.

Prepared for Jefferson Borough and South Park Township, PA, June 1971, 29 p, 7 fig, 8 plates, 5 tab.

Descriptors: *Pennsylvania, *Indirect flood measurement, *Flood forecasting, *Flood profiles, *Flood data, Floods, Flood flow, Storms, Historic floods, Flood stages, Peak discharge, Flow duration, Stage-discharge relations, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, Control structures, *Peters Creek(PA), Jefferson Borough(PA), Allegheny County(PA), South Park Township(PA), Intermediate Regional Flood.

The study area includes Peters Creek and its flood plain in Jefferson Borough and part of South Park Township in Allegheny County, Pennsylvania. Except for a single commercial development, the flood plain is brush or tree covered and undeveloped. Flood data were obtained from topographic maps, field studies, historical sources, and stream gage records. The main flood season is from spring through fall and results from intense local thunderstorms or heavy general rains. Serious flooding may occur at other times. The worst flood of record occurred on August 19, 1969, cresting at 767.7 feet mean sea level (msl) and discharging 4,400 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood (IRF) would crest at 769.3 feet msl, discharging 9,300 cfs, while the Standard Project Flood would crest at 771.0 feet msl, discharging 14,000 cfs. Several bridges across Peters Creek would block the flow of the IRF. Flood damage

will not be used in making decision (Nessa-NC)

FLOOD PLAIN INFORMATION: CREEK, STONY, PENNSYLVANIA. Army Engineer District, Pittsburgh, PA, Prepared for Allegheny County, December 1971, 42 p.

Descriptors: *Pennsylvania, *Indirect flood measurement, *Flood forecasting, *Flood profiles, *Flood data, Floods, Flood flow, Storms, Historic floods, Flood stages, Stage-discharge relations, Rivers, Flood plains, Flood protection, Non-structural alternatives, Land use, Planning, Control structures, Standard Project Flood, *Conemaugh River(PA), Johnstown(PA), Cambria County(PA), Somerset County(PA), Stony Creek(PA), Bens Creek(PA), Intermediate Regional Flood.

The study area involves Creek and Stony Creek and its tributaries in the vicinity of the City of Johnstown in Cambria and Somerset Counties, Pennsylvania. Most of the study area is densely developed with residential, commercial and industrial land uses. Bens Creek, a tributary to the Conemaugh in the study area, is sparsely developed. Flood data were obtained from topographic maps, field studies, historical sources, and intermittent and permanent stream gage records. The main flood season is December through April, and results from rainfall combined with snowmelt. Intense local thunderstorms may cause flooding at other times. The worst known flood was the famous Johnstown flood of May 31, 1889, which resulted from a collapsed dam. The worst flood without unnatural augmentation occurred on March 18, 1936, cresting at 22.8 feet above flood stage and discharging 90,000 cubic feet per second (cfs). Structural flood prevention measures completed in November 1943 protect much of the developed area from floods as large as the Intermediate Regional Flood (IRF). At stream mile 52.06 on the Conemaugh River, the IRF will crest 28.25 feet above flood stage and discharge 83,000 cfs while the Standard Project Flood (SPF) will crest 35.5 feet above flood stage and discharge 128,000 cfs. The IRF is larger than the 1936 flood. There are 13 bridges in the study area that are obstructive to major flood flows; 9 of these are obstructive to the IRF. This report will facilitate land use planning and management decisions. (Nessa-NC)

W78-03906

FLOOD PLAIN INFORMATION: PETERS CREEK, JEFFERSON BOROUGH, ALLEGHENY COUNTY, PENNSYLVANIA. Army Engineer District, Pittsburgh, PA, Prepared for Jefferson Borough and South Park Township, PA, June 1971, 29 p, 7 fig, 8 plates, 5 tab.

Descriptors: *Pennsylvania, *Indirect flood measurement, *Flood forecasting, *Flood profiles, *Flood data, Floods, Flood flow, Storms, Historic floods, Flood stages, Peak discharge, Flow duration, Stage-discharge relations, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, Control structures, *Peters Creek(PA), Jefferson Borough(PA), Allegheny County(PA), South Park Township(PA), Intermediate Regional Flood.

The study area includes Peters Creek and its flood plain in Jefferson Borough and part of South Park Township in Allegheny County, Pennsylvania. Except for a single commercial development, the flood plain is brush or tree covered and undeveloped. Flood data were obtained from topographic maps, field studies, historical sources, and stream gage records. The main flood season is from spring through fall and results from intense local thunderstorms or heavy general rains. Serious flooding may occur at other times. The worst flood of record occurred on August 19, 1969, cresting at 767.7 feet mean sea level (msl) and discharging 4,400 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood (IRF) would crest at 769.3 feet msl, discharging 9,300 cfs, while the Standard Project Flood would crest at 771.0 feet msl, discharging 14,000 cfs. Several bridges across Peters Creek would block the flow of the IRF. Flood damage

WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Control Of Water On The Surface—Group 4A

will not be significant. This report is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03907

FLOOD PLAIN INFORMATION: FRENCH CREEK, COCHRANTON, CRAWFORD COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.
Prepared for Town of Cochranton, September 1971, 42 p, 10 fig, 10 plates, 10 tab.

Descriptors: *Pennsylvania, *Indirect flood measurement, *Flood forecasting, *Flood profiles, *Flood data, Floods, Storms, Historic floods, Flood stages, Peak discharge, Stage-discharge relations, Rivers, Flood plains, Ice jams, Flood protection, Standard Project Flood, Non-structural alternatives, Land use, Planning, Control structures, Dikes, Dams, Reservoirs, Cochranton(PA), *French Creek(PA), Crawford County(PA), Intermediate Regional Flood, Little Sugar Creek(PA).

The study area includes the flood plain of French Creek and Little Sugar Creek in the vicinity of Cochranton Borough, Pennsylvania, and parts of Wayne, Fairfield, East Fairfield and Union Townships. The flood plain is largely undeveloped, with scattered residential, commercial, and seasonal structures. Flood data were obtained from topographic maps, field studies, aerial photographs, precipitation records, and stream gages. The main flood season occurs from December through April, usually resulting from heavy rains. The worst known flood on French Creek occurred in March 1913. Other serious recent floods occurred in January 1959 and April 1960. In April 1960, flood waters at the Corps of Engineers stream gage crested at 1059.9 feet mean sea level (msl), discharging 25,000 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood (IRF) is expected to crest at 1063.2 feet msl, and discharge 35,000 cfs, while the Standard Project Flood (SPF) will crest at 1065.2 feet msl and discharge 45,000 cfs. The 1959 flood heights were more serious due to ice jams. The SPF and IRF would cause some damage to residential and commercial properties. Future flooding will be modified by the construction of three proposed reservoirs upstream of Cochranton; it is expected that major flood heights will be reduced by 2 feet with all three projects completed. This report will be useful in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03908

FLOOD PLAIN INFORMATION: CLARION RIVER AND SILVER CREEK, JOHNSONBURG, ELK COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.
Prepared for Borough of Johnsonburg, PA, December 1971, 41 p, 10 fig, 9 plates, 8 tab.

Descriptors: *Pennsylvania, *Flood forecasting, *Flood data, *Peak discharge, Floods, Flood flow, Indirect flood measurement, Flood profiles, Storms, Historic floods, Flood frequency, Flood stages, Flow duration, Flood damage, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Zoning, Control structures, Dikes, Channel improvement, Standard Project Flood, *Clarion River(PA), *Silver Creek(PA), Elk County(PA), Johnsonburg(PA), Intermediate Regional Flood.

The study area includes Silver Creek, the Clarion River and its two branches within the limits of the Borough of Johnsonburg in Elk County, Pennsylvania. Some residential, industrial and commercial developments exist on these flood plains. Flood data were obtained from topographic maps, field studies, historical sources and stream gage records. The main flood season occurs from

January through May and results from heavy rain and snowmelt. Intense local thunderstorms may cause flooding at other times. The worst flood of record occurred on July 18, 1942. A dam constructed on the East Branch will affect future flooding. The Intermediate Regional Flood (IRF) is expected to be 6.0, 10.0, and 0.5 feet lower than the July 1942 flood on the Clarion River, East Branch, and Silver Creek, respectively. The West Branch, which is not affected by the dam, would experience an IRF exceeding the 1942 flood by one foot. The Standard Project Flood (SPF) would be 2.0 and 5.0 feet lower than the 1942 flood on the Clarion River and East Branch, respectively. The SPF would be 6.0 and 0.5 feet higher than the 1942 flood on the West Branch and Silver Creek, respectively. This report will facilitate land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03909

FLOOD PLAIN INFORMATION: HARE AND BEAR CREEKS, CORRY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.
Prepared for City of Corry, PA, September 1967, 31 p, 8 fig, 5 plates, 3 tab.

Descriptors: *Pennsylvania, *Flood forecasting, *Flood data, *Peak discharge, Floods, Indirect flood measurement, Flood profiles, Storms, Historic floods, Flood stages, Flow duration, Stage-discharge relations, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, Control structures, Corry(PA), *Hare Creek(PA), *Bear Creek(PA), Erie County(PA), Intermediate Regional Flood.

The study area includes the flood plains of Hare and Bear Creeks in the vicinity of Corry in Erie County, Pennsylvania. Development on the flood plain is limited, consisting of a public utility and some residential and commercial structures. Flood data were obtained from topographic maps, profiles, and field studies. Little historical data were available. The main flood season extends from January through April and results from either rainfall alone or in combination with snowmelt. The greatest known flood occurred in April 1947. At the downstream limit of the study area, the Intermediate Regional Flood (IRF) is expected to discharge 5,300 cubic feet per second (cfs), while the Standard Project Flood (SPF) will discharge 20,000 cfs. The IRF flood height would vary from two to six feet above flood stage, while the SPF would vary from 2.5 to 12.5 feet above flood stage. Two bridges on Hare Creek would significantly affect SPF and IRF heights. This report is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03910

FLOOD PLAIN INFORMATION: MONONGAHELA RIVER, CALIFORNIA, COAL CENTER, AND WEST BROWNSVILLE, WASHINGTON COUNTY, PENNSYLVANIA.

Army Engineer District, Pittsburgh, PA.
Prepared for Washington County Planning Commission, PA, June 1970, 41 p, 7 fig, 21 plates, 6 tab.

Descriptors: *Pennsylvania, *Flood forecasting, *Flood profiles, Historic floods, *Flood data, Floods, Flood flow, Indirect flood measurement, Flood profiles, Storms, Flood frequency, Flood stages, Peak discharge, Flow duration, Flow characteristics, Stage-discharge relations, Flood damage, Rivers, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, Control structures, Dams, Reservoirs, *Monongahela River(PA), California(PA), Coal Center(PA), West Brownsville(PA), Washington County(PA), Intermediate Regional Flood.

The study area involves a 6.5 mile reach of the Monongahela River located in the Washington

County Boroughs of California, Coal Center, and West Brownsville, Pennsylvania. The flood plain is largely developed with residential and commercial land uses. Most residential sections are located on high ground, outside of the flood zone. Flood data were obtained from topographic maps, field studies, historical sources, and intermittent and permanent stream gage records. The main flood season occurs from December through March and results from rainfall combined with snowmelt. Intense thunderstorms may cause flooding at other times. The worst flood of record occurred on March 7, 1967. At the Brownsville Lock and Dam, this flood crested at 770.9 feet mean sea level (msl) and discharged 158,000 cubic feet per second (cfs). Another large flood occurred in March 1963 and was about 2 feet lower than the 1967 flood. At the same location, the Intermediate Regional Flood (IRF) would crest at 771.0 feet msl and discharge 181,000 cfs, while the Standard Project Flood (SPF) would crest at 774.5 feet msl and would discharge 213,500 cfs. Historic and future flood profiles are also provided for other locations in the study area. Tygart Dam and Reservoir, WV, operated since 1938 by the U.S. Corps of Engineers, has been effective in reducing major flood peaks by an average of 4 feet. Two additional dams have been authorized and they will further reduce flood peaks on the Monongahela River. This report will facilitate land use planning and management decisions regarding future flood plain utilization. (Nessa-NC)
W78-03911

FLOOD PLAIN INFORMATION: BLACKSTONE RIVER, CUMBERLAND, LINCOLN, CENTRAL FALLS, AND PAWTUCKET, RHODE ISLAND.

Army Engineer District, Waltham, MA.
Prepared for Towns of Cumberland, Lincoln, Central Falls, and Pawtucket, RI, June 1971, 48 p, 10 fig, 15 plates, 7 tab.

Descriptors: *Rhode Island, *Flood forecasting, *Flood profiles, Historic floods, *Flood data, Floods, Flood flow, Indirect flood measurement, Storms, Flood stages, Peak discharge, Flood frequency, Flow duration, Stage-discharge relations, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Control structures, Dams, Cumberland(RI), Lincoln(RI), Central Falls(RI), *Pawtucket(RI), *Blackstone River(RI), Intermediate Regional Flood.

The study area involves the portions of Cumberland, Lincoln, Central Falls, and Pawtucket, Rhode Island, that are subject to flooding from the Blackstone River, a stretch of 10.6 miles. The flood plain contains residential, commercial, and industrial land uses. Four bridges would obstruct the Intermediate Regional Flood (IRF) flow, while 13 bridges obstruct the Standard Project Flood (SPF) flow. The main flood seasons are spring and fall, resulting from heavy rains accompanying tropical hurricanes. A flood control dam and reservoir has been in operation since 1961 and this reduces flood flows on the Blackstone River. Flood data were obtained from topographic maps, historical sources, field studies, stream gage records, and hydrologic analysis of similar watersheds in the area. The worst flood recorded at Woonsocket occurred on August 19, 1955, discharging 32,900 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood is expected to discharge 22,000 cfs, while the Standard Project Flood (SPF) would discharge 40,000 cfs. The IRF would be one foot lower than the 1955 flood, while the SPF would be four feet higher. The 1955 flood would have been less severe if the existing structural flood controls had been in place, with a modified discharge of 26,100 cfs. This study is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03912

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control Of Water On The Surface

FLOOD PLAIN INFORMATION: WEST BRANCH SUSQUEHANNA RIVER (EAST), LYCOMING COUNTY, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
Prepared for Lycoming County Planning Commission, PA, April 1974, 39 p, 3 fig, 13 plates, 7 tab.

Descriptors: *Pennsylvania, Historic floods, *Flood data, *Peak discharge, Floods, Flood flow, Indirect flood measurement, Streamflow forecasting, Flood forecasting, Flood profiles, Storms, Flood frequency, Flood stages, Flow duration, Stage-discharge relations, Flood damage, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Control structures, Reservoirs, Lycoming County(PA), *West Branch Susquehanna River(East) (PA), Muncy(PA), Montgomery(PA), Brady Township(PA), Clinton Township(PA), Fairfield Township(PA), Muncy Township(PA), Muncy Creek Township(PA), Intermediate Regional Flood.

The study area involves the portions of Lycoming County, Pennsylvania that are subject to flooding from the West Branch Susquehanna River, a reach of about 13 miles. Included are the Boroughs of Muncy and Montgomery and the Townships of Brady, Clinton, Fairfield, Muncy and Muncy Creek. The flood plain contains residential, commercial, and light industrial developments in Muncy and Montgomery. Elsewhere, the flood plain contains only scattered residential sites and transportation routes. Flood data were obtained from topographic maps, historical sources, field studies and stream gage records. Four upstream reservoirs help reduce flood heights in the study area. Most floods occur in the late winter and early spring and result from heavy rain combined with snowmelt. Intense rainfall at other times of year have caused some of the worst known floods. The largest flood of record occurred on June 23, 1972 as a result of tropical storm Agnes. At the upstream study limit, the Intermediate Regional Flood (IRF) will discharge 300,000 cubic feet per second (cfs) compared to the 1972 flood volume of 295,000 cfs. At the upstream study limit the IRF will crest two feet below the 1972 crest, while at the downstream study limit, the IRF crest will be 1 foot higher. The upstream Standard Project Flood (SPF) volume will be 415,000 cfs. Compared to the 1972 flood, upstream crests will be three feet higher while downstream crests will be six feet higher. This report is intended for use in land use planning and management concerning flood plain utilization. (Nessa-NC)
W78-03914

FLOOD PLAIN INFORMATION: FRANKSTOWN BRANCH JUNIATA RIVER, WILLIAMSBURG, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
Prepared for Blair County Planning Commission, PA, June 1974, 23 p, 8 fig, 10 plates, 6 tab.

Descriptors: *Pennsylvania, Historic floods, *Flood data, *Peak discharge, Floods, Indirect flood measurement, Flood forecasting, Flood profiles, Storms, Flood stages, Flow duration, Stage-discharge relations, Flood damage, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Control structures, *Frankstown Branch Juniata River(PA), Williamsburg(PA), Catherine Township(PA), Blair County(PA), Woodbury Township(PA), Intermediate Regional Flood.

The study area includes the portions of the Borough of Williamsburg and the Townships of Catherine and Woodbury that are subject to flooding from the Frankstown Branch of the Juniata River. The flood plain consists primarily of commercial, residential and industrial properties. Flood data were obtained from topographic maps, field studies, historical records, and a U.S. Geological Survey stream gage. Flooding occurs at

any time of year and results from heavy general rainfall, hurricane induced rains, and snowmelt. The worst known flood occurred on March 18, 1936, cresting at 850.4 feet mean sea level (msl) and discharging 47,600 cubic feet per second (cfs). At the same location, the Intermediate Regional Flood (IRF) will discharge 35,000 cfs and crest at 855.8 feet msl, while the Standard Project Flood (SPF) will discharge 96,000 cfs and crest at 868.93 feet msl. These floods would cover a substantial portion of the flood plain in the Borough of Williamsburg. All five of the bridges in the study area are obstructive to SPF or IRF flood flows. Less severe floods will affect approaches to these structures. This report is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03914

FLOOD HAZARD REPORT: SHICKSHINNY CREEK, LUZERNE COUNTY, PENNSYLVANIA.

Army Engineer District, Baltimore, MD.
Prepared for Luzerne County Planning Commission, PA, April 1974, 8 p, 2 plates, 1 tab.

Descriptors: *Pennsylvania, *Streamflow forecasting, *Flood data, Floods, Indirect flood measurement, Flood forecasting, Flood profiles, Historic floods, Flood stages, Peak discharge, Flood damage, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, Luzerne County(PA), *Shickshinny Creek(PA), Shickshinny Borough(PA), Intermediate Regional Flood.

The study area includes Shickshinny Creek and its flood plain in Luzerne County, Pennsylvania, from the creek's confluence with the Susquehanna River to Koonsville. Most of the flood plain is wooded and undeveloped, with residential and commercial land uses concentrated in the downstream portion of the study area. Flood data were obtained from topographic maps, historical sources and hydrologic data from nearby watersheds. No Shickshinny Creek gage records were available. Flooding occurs at any time of year, resulting from heavy rains, snowmelt, or backwater flooding from the Susquehanna River. The worst known flood occurred in 1972, and caused \$12.6 million dollars damage in the Borough of Shickshinny. Damage upstream was not significant. At the mouth of the creek, and Intermediate Regional Flood is expected to discharge 4,300 cubic feet per second (cfs), while the Standard Project Flood will discharge 14,000 cfs. There are no existing, authorized, or proposed structural flood control measures either within or upstream from the study area. This study is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03915

FLOOD PLAIN INFORMATION: BIG SANDY RIVER, WAYNE COUNTY, WEST VIRGINIA.
Army Engineer District, Huntington, WV.

Prepared for State of West Virginia, Department of Natural Resources, June 1972, 43 p, 7 fig, 18 plates, 12 tab.

Descriptors: *West Virginia, *Flood forecasting, *Flood profiles, Historic floods, *Flood data, Floods, Flood flow, Indirect flood measurement, Storms, Flood frequency, Flood stages, Peak discharge, Flow duration, Stage-discharge relations, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Warning systems, Land use, Planning, Control structures, Levee, Floodwalls, *Big Sandy River(WV), Wayne County(WV), Intermediate Regional Flood.

The study area involves the West Virginia bank of the Big Sandy River in Wayne County. Residential, commercial, industrial, and public utility

land uses within the Standard Project Flood plain are sparse. Flood data were obtained from topographic maps, field studies, historical sources, and stream gage records. The main flood season occurs from January through April and results from heavy general rainfall over the entire upstream drainage area. The worst known flood recorded at the confluence of the Big Sandy and Ohio Rivers occurred on January 27, 1937, and crested 29.5 feet above flood stage. At the same location, the Intermediate Regional Flood (IRF) would crest 22.5 feet above flood stage, and the Standard Project Flood (SPF) would crest 26.0 feet above flood stage. Flood control structures built since the 1937 flood should prevent the recurrence of such a large flood, and they also reduce the potential magnitude of the IFR and SPF. These structures consist of levees and floodwalls constructed by the Corps of Engineers, with a gradient of 3 feet above the level of the 1937 flood. This study is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03916

FLOOD HAZARD INFORMATION: BUFFALO CREEK, LOGAN COUNTY, WEST VIRGINIA—POST DISASTER CONDITIONS.

Army Engineer District, Huntington, WV.
April 1972, 9 p, 4 fig, 39 plates, 1 tab.

Descriptors: *West Virginia, *Flood data, *Flood damage, Floods, Flash flood, Regional Flood, Flood flow, Indirect flood measurement, Streamflow forecasting, Maximum probable flood, Flood profiles, Flood frequency, Flood recurrence interval, Flow characteristics, Erosion, Stream erosion, Deposition(Sediments), Frail lands, Bank erosion, Flood plains, Standard Project Flood, Flood protection, Non-structural alternatives, Land use, Planning, *Logan County(WV), *Buffalo Creek(WV), Post disaster conditions, Intermediate Regional Flood.

The study area involves the portions of Logan County, West Virginia that are subject to flooding by Buffalo Creek. The study's purpose is to evaluate the changes in the flood carrying capacity of the stream and its flood plain that resulted from a disastrous impoundment failure on February 26, 1972, when extensive damage was done to natural and manmade obstructions and impediments. The flood plain is almost completely developed, especially with residential land uses. Thirty-nine bridges cross the creek. Flood data were obtained from aerial photos, topographic maps, and field studies. Flood plain and stream channel changes resulting from the 1972 flood include the elimination of manmade impediments to flood flow, the deposition of upstream debris at downstream locations, and realignment of the stream channel. At the mouth of Buffalo Creek, the Intermediate Regional Flood is expected to crest at 737.8 feet mean sea level, while the Standard Project Flood would crest at 755.4 feet mean sea level. These projections reflect changes in the hydraulic characteristics of the stream that will result from the elimination of flood debris. This study is intended for use in making land use planning and management decisions concerning flood plain utilization. (Nessa-NC)
W78-03917

AN ECONOMIC OVERVIEW OF HAWAII'S WATER INSTITUTIONS,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 6E.
W78-03930

MODELS FOR ASSESSING THE ECONOMIC VALUE OF HYDROPOWER FOR PEAKING PURPOSES AND THE PRICING OF PEAKING ALTERNATIVES,
Washington State Water Research Center, Pullman.

For primary
W78-03964

URBAN SYSTEMS EXTENSION
Arizona Wa-
son.
For primary
W78-03965

DESIGN OF SYSTEMS
Technion-Is-
Civil Engine-
For primary
W78-03997

SNOW CON-
Guelph Uni-
For primary
W78-04030

WATER PLANNING
MULTIPLE Washingt-
and Enviro-
For primary
W78-04106

REPORT OF GLAND BALANCE SECTION OF RESOURCES AND RHO-MA.
New Engla-
MA.
For primary
W78-04146

**TRIAL AP-
TION PRO-
NESSEE.**
Tennessee.
For primary
W78-04148

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**LANDSAT TOOL FOR IN NORTH-
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H. C. Mach Available
Price code:
Publication 55 ref. 5
0001-6004.**

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WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Groundwater Management—Group 4B

For primary bibliographic entry see Field 6D.

W78-03964

URBAN FLOOD WATER MANAGEMENT SYSTEMS IN SEMIARID REGIONS: MODEL EXTENSION, DESIGN AND APPLICATION, Arizona Water Resources Research Center, Tucson.

For primary bibliographic entry see Field 6A.

W78-03965

DESIGN OF OPTIMAL WATER DISTRIBUTION SYSTEMS,

Technion-Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.

For primary bibliographic entry see Field 8B.

W78-03997

SNOW CONTROL BY MODEL TECHNIQUES,

Guelph Univ. (Ontario). School of Engineering.

For primary bibliographic entry see Field 2C.

W78-04030

WATER RESOURCES MANAGEMENT AND PLANNING: OPTIMIZATION MODELING OF MULTIPLE RESERVOIR SYSTEMS,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.

For primary bibliographic entry see Field 6A.

W78-04106

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY—A STRATEGY FOR BALANCED DEVELOPMENT AND PROTECTION OF WATER AND RELATED LAND RESOURCES IN EASTERN MASSACHUSETTS AND RHODE ISLAND. New England River Basins Commission, Boston, MA.

For primary bibliographic entry see Field 6B.

W78-04146

TRIAL APPLICATION OF REVISED EVALUATION PROCEDURES AT KINGSPORT, TENNESSEE.

Tennessee Valley Authority, Kingsport.

For primary bibliographic entry see Field 6B.

W78-04148

4B. Groundwater Management

LANDSAT LINEAR TREND ANALYSIS: A TOOL FOR GROUNDWATER EXPLORATION IN NORTHERN ARKANSAS, Arkansas Univ., Fayetteville. Water Resources Research Center.

H. C. MacDonald, K. F. Steele, and E. Gaines.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 121, Price codes: A06 in paper copy, A01 in microfiche. Publication No. 49, June 1977. 108 p., 24 fig., 3 tab., 55 ref., 5 append. OWRT A-034-ARK (1), 14-34-0001-6004.

Descriptors: *Remote sensing, *Groundwater exploration, *Arkansas, Aquifer characteristics, *Linear trend analysis, Landsat data, Aerial photography.

In northern Arkansas, knowledge of deep aquifers is fairly limited. The development of these deeper aquifers to their fullest potential as reliable water sources depends upon the delineation of high yield areas, a process that may be facilitated by linear trend analysis. Satellite and photolineament maps of the 13 counties were prepared by use of LANDSAT images and Agricultural Stabilization and Conservation Service photo indexes. The lineaments and fracture traces on aerial photographs and LANDSAT images are natural linear features

such as aligned stream segments, soil tonal and vegetal alignments, and topographic sags. These features are the surface manifestations of subsurface fracture zones of undermined origin, which are areas where increased solution of carbonate rocks has taken place. The results of statistical testing of well yields in the study area show that the fracture trace-lineament method of well location can result in improved well yields. Linear trends interpreted from LANDSAT can be useful in the search for more reliable groundwater sources. (Smiley-Arkansas)

W78-03752

RECHARGE AND NITROGEN TRANSPORT MODELS FOR NASSAU AND SUFFOLK COUNTIES, N. Y.,

Cornell Univ., Ithaca, NY. Center for Environmental Research.

For primary bibliographic entry see Field 5B.

W78-03756

IMPACT OF GROUNDWATER DEVELOPMENT IN ARID LANDS: A LITERATURE REVIEW AND ANNOTATED BIBLIOGRAPHY, Arizona Univ., Tucson. Office of Arid Lands Studies.

S. Jo Keith.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-276 908, Price codes: A08 in paper copy, A01 in microfiche. Arid Lands Resource Information Paper, No 10, 1977, 139 p., 34 fig., 13 tab., 318 ref. OWRT W-197(5254)(2).

Descriptors: *Groundwater, *Water resources development, *Land subsidence, *Arizona, Wells, Springs, Streamflow, Pumping, Environmental effects, Social aspects, Salinity, Water quality, Subsidence, Saline water intrusion, Vegetation, Economic impact, Arid lands, Technology, Water management(Applied), *Bibliographies, Agriculture, *Pakistan, Tubewells, Papago Indians, Industrial linkages, Institutional aspects, Developing countries, Economic development, Appropriate technology.

As groundwater comes increasingly under development, it is imperative, for economic, ecological, and political reasons, to anticipate the impact of its development. The literature is reviewed on this impact in arid lands in terms of two general categories: physical environment impacts and socioeconomic impacts. Two case studies are presented: one focuses on the impact of groundwater development on the Papago Indians, illustrating the cultural and subsequent environmental changes occurring when an assured groundwater supply is developed within an area of previous water scarcity inhabited by a seminomadic people; the second, through a discussion of groundwater development in Pakistan, demonstrates the role groundwater development can play in the economic development process in developing arid countries. The impact of groundwater development is not simply the result of the withdrawal of water. Technology, through its growth and appropriateness, and institutions influence very much the type and magnitude of the impact of groundwater development. It is through an understanding of these roles that desirable impacts can be promoted and undesirable impacts mitigated. (Keith-Arizona)

W78-03757

LEACHATE PLUMES IN GROUND WATER FROM BABYLON AND ISLIP LANDFILLS, LONG ISLAND, NEW YORK, Geological Survey, Mineola, NY. Water Resources Div.

For primary bibliographic entry see Field 5B.

W78-03759

DIGITAL MODEL OF THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING, Geological Survey, Cheyenne, WY. Water Resources Div.

For primary bibliographic entry see Field 2F.

W78-03761

OCCURRENCE AND DISTRIBUTION OF COLOR AND HYDROGEN SULFIDE IN WATER FROM THE PRINCIPAL ARTESIAN AQUIFER IN THE VALDOSTA AREA, GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.

For primary bibliographic entry see Field 5B.

W78-03762

WATER-RESOURCES INVESTIGATIONS IN NORTH DAKOTA, 1976, Geological Survey, Bismarck, ND. Water Resources Div.

For primary bibliographic entry see Field 7C.

W78-03764

WATER-RESOURCES INVESTIGATIONS IN ARIZONA, 1977, Geological Survey, Tucson, AZ. Water Resources Div.

For primary bibliographic entry see Field 7C.

W78-03765

GROUND-WATER LEVELS IN WYOMING, 1976, Geological Survey, Cheyenne, WY. Water Resources Div.

For primary bibliographic entry see Field 7C.

W78-03768

CHANGES IN AQUIFER-SYSTEM PROPERTIES WITH GROUND-WATER DEPLETION, Geological Survey, Sacramento, CA. Water Resources Div.

B. E. Logren.

Paper presented at the 11th Biennial Ground Conference, held in Fresno, California, September 15-16, 1977. 34 p., 12 fig., 11 ref. Published as USGS report.

Descriptors: *Groundwater, *Drawdown, *Land subsidence, *Withdrawal, *California, Forecasting, Analytical techniques, Aquitards, Data collections, Aquifer characteristics, Groundwater recharge, Imported water, Water supply, Water demand, Droughts, Water management(Applied), *San Joaquin Valley(Calif).

After three decades of pumping overdraft, water-level decline, and widespread subsidence, water levels in half of the San Joaquin Valley, California, rose rapidly due to the importation of canal waters. By late 1975, artesian heads had recovered to their late 1940 levels. Then followed the drought years of 1976 and 1977, and renewed pumping overdraft. The stress-strain characteristics and storage parameters of the confined aquifer system have been calculated using the results of 20 years of precise field research. From these characteristics and parameters the close interrelationship between future ground-water depletion, water-level decline, and subsidence can be predicted. (Woodard-USGS)

W78-03769

DEFINING REACTIONS AND MASS TRANSFER IN PART OF THE FLORIDAN AQUIFER, Geological Survey, Reston, VA. Water Resources Div.

For primary bibliographic entry see Field 2F.

W78-03770

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4B—Groundwater Management

GROUND-WATER RESOURCES OF CENTRAL AND SOUTHERN YORK COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W78-03771

SOURCES OF EMERGENCY WATER SUPPLIES IN SANTA CLARA COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6D.
W78-03772

WATER RESOURCES OF OKALOOSA COUNTY AND ADJACENT AREAS, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. Trapp, Jr., C. A. Pascale, and J. B. Foster.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 042, Price codes: A05 in paper copy, A01 in microfiche. Water-Resources Investigations 77-9, August 1977, 83 p, 32 fig, 4 tab, 35 ref.

Descriptors: *Water supply, *Available water, *Groundwater, *Surface waters, *Florida, Aquifer characteristics, Water wells, Pumping, Drawdown, Specific capacity, Transmissivity, Hydrogeology, Saline water intrusion, Groundwater recharge, Streamflow, Flow rates, Water quality, Evaluation, Okaloosa County(Fla).

Okaloosa County, in the northwest Florida panhandle, uses the Floridian aquifer for water supply, although it also has abundant surface water and ground water in the surficial sand-and-gravel aquifer. Water levels have declined locally more than 90 feet in the upper limestone of the Floridian aquifer. The Floridian aquifer is overlain by the Pensacola clay confining bed, and the Bucatunna Clay subdivides it into two limestone units. Water in the upper limestone is generally of good quality. The lower limestone probably contains saline water. Average daily stream discharge is about 2,500 million gallons. Stream discharge does not diminish excessively during droughts, owing to high base runoff. Water levels in the Floridian aquifer will decline as long as pumping increases in the present areas of withdrawal. The decline could be alleviated by redistribution of pumping, artificial recharge, and the use of the sand-and-gravel aquifer or streams. (Woodard-USGS)
W78-03774

ARTIFICIAL-RECHARGE EXPERIMENTS NEAR LAKIN, WESTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.; and Kansas Water Resources Board, Topeka.
J. B. Gillespie, G. D. Hargadine, and M. J. Stough, Kansas Water Resources Board, Bulletin No 20, 1977. 91 p, 58 fig, 5 tab, 17 ref, append.

Descriptors: *Artificial recharge, *Groundwater recharge, *Water spreading, *Kansas, *Irrigation wells, Pit recharge, Infiltration, Water quality, Leaching, Ion exchange, Loess, Moisture content, Analytical techniques, Demonstration watersheds, Evaluation, *Lakin area(Kans), Kearny County, Arkansas River.

The irrigation economy of the High Plains of Kansas probably will decline if the depletion of ground water from storage in the major aquifers continues to accelerate. Experiments have been made in western Kansas to investigate artificial recharge as a possible means of alleviating the problem. Possible sources of water for artificial recharge are storm runoff, irrigation tail water, and imported surface water. The artificial-recharge experimental site near Lakin, Kansas, is underlain by about 1.5 feet of loessial soil, 12 feet of loess, and 170

feet of undifferentiated Pliocene (Ogallala Formation) and Pleistocene deposits overlying shale of the Dakota Formation. Depth to the water table is about 65 feet. The unconsolidated material in the unsaturated zone consists mainly of silt and clayey silt with some layers of sand and gravel. Unconsolidated material in the upper part of the saturated zone consists mostly of fine sand. Artificial recharge experiments were conducted in three small ponds using ground water and one small pond using surface water from the Arkansas River. As the infiltrated water percolated to the water table, changes in chemical quality were monitored by sampling through porous cups installed at various depths in the unsaturated zone. After infiltration of 120 feet of water, leaching had nearly stabilized and the chemical quality of water reaching the water table was similar to that of the input water. The data collected indicate that artificial recharge of alluvial aquifers by water spreading could be accomplished on most of the High Plains of Kansas, provided that water for recharge were available. (Woodard-USGS)
W78-03775

PRELIMINARY EVALUATION OF GROUND WATER IN THE PRE-PENNSYLVANIAN CARBONATE ROCKS, MCCOY AREA, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
E. R. Hampton.
Open-file report, 1974. 11 p, 1 fig, 1 plate, 2 tab, 11 ref.

Descriptors: *Groundwater resources, *Observation wells, *Water yield, *Water quality, *Colorado, Carbonate rocks, Aquifer characteristics, Groundwater availability, Water analysis, Chemical analysis, *McCoy area(Colo).

Oil-test drilling in 1953 and 1962 suggested the presence of a substantial ground-water reservoir in the pre-Pennsylvanian carbonate rocks in the McCoy, Colo., area. Four water wells drilled in 1971 confirmed the presence of such a reservoir. In the 17 square-mile area near McCoy, an estimated 43,000 acre-feet of recoverable ground water is stored in the pre-Pennsylvanian carbonate aquifer. Dissolved-solids concentration of water from four wells range from 755 to 4,670 milligrams per liter, and fluoride ranges from 3.9 to 5.6 milligrams per liter. The measured flow from one of the wells drilled in 1971 was 3,200 gallons per minute. (Woodard-USGS)
W78-03776

SEEPAGE TESTS ON NO NAME CREEK, COLVILLE INDIAN RESERVATION, WASHINGTON, MAY 12-13, 1977,
Geological Survey, Tacoma, WA. Water Resources Div.
R. D. Mac Nish.
Open-file report 77-618, 1977. 8 p, 2 fig, 1 tab.

Descriptors: *Seepage, *Surface-groundwater relationships, *Watershed management, *Infiltration rates, *Chlorides, Gravitational water, Analytical techniques, Data collection, *Indian reservations, *Washington, *Colville Indian Reservation(Wash), *No Name Creek(Wash).
W78-03783

To gain information for a water-management situation, a seepage test was performed on May 12-13, 1977, on a reach of No Name Creek on the Colville Indian Reservation in north-central Washington. On May 13, injection of a concentrated brine at the head of the test reach permitted chloride-concentration data to be combined with the discharge measurements made to define the pattern of gain and loss along the reach. Equations describing discharge and chloride mass balance were used to determine this pattern of gain and loss. The seepage tests showed that the streamflow gain of at least 0.58 cfs from springflow contributions was offset by losses of at least 0.59 cfs over the same reach. (Woodard-USGS)

W78-03777

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1976.
Geological Survey, Boise, ID. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-03780

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 2. EASTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-03781

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 1. WESTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03782

GEOHYDROLOGICAL STUDIES IN SMALL AREAS WITHOUT SYSTEMATIC DATA,
E. C. Gimena.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 77-93, 1974. 3 fig, 15 ref.

Descriptors: *Water resources development, *Groundwater resources, *Evaluation, *Analytical techniques, Water balance, Groundwater movement, Geochemistry, Water quality, Rainfall, Infiltration, Evapotranspiration, Methodology, Meteorology, Model studies, Sal balance, Foreign research, Foreign countries, Groundwater recharge, *Spain, Inadequate data.

Frequently studies are needed to derive benefits from groundwater resources by means of wells or galleries in areas with non-existing data on river and spring flows and on recharge, but in which damages may be imposed on pre-existing water uses. Results of groundwater recharge calculations were presented for three case studies. The recharge calculations were based upon modified hydro meteorological balance, groundwater flow using hydrodynamics based on existing or estimated data, and geo hydrochemical method. In areas with small infiltration in relation to the pluviometry, the geo hydrochemical method applied with precautions was a very useful tool which can improve the hydro meteorological balance method. In more humid areas, the results were not so clear. The hydrodynamic balance was the best method, but in some cases it needs appropriate conditions for application. In any case, the method requires numerous field tests to determine the hydrodynamic characteristics of the aquifer. (See also W78-03783) (Humphreys-ISWS)

W78-03787

DESIGNING PROJECTS FOR THE DEVELOPMENT OF GROUND WATER RESOURCES IN THE ALLUVIAL PLAINS OF NORTHERN INDIA ON THE BASIS OF INADEQUATE DATA,
B. K. Sabherwal.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 365-381, 1974. 2 tab, 16 ref, 2 map.

Descriptors: *Groundwater resources, *Water resources development, *Water balance, Foreign countries, Hydrologic aspects, Water utilization,

Groundwater Aquifers, A data.

Preparation for the explore over till the four to five necessary to a methodological with the groundwater keeping man better data techniques mate evaluate table aquifer reference to Punjab-India where 90% member. A s is the recharge flow of about water through irrigation canals cropped for withdrawal shallow an 03783) (Hun W78-03799

PROSPECTS
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I. L. Glass.
Energy, Vol 11 fig, 5 tab

Descriptors, The Nuclear ex power p environmental Hydraulic Nuclear fra

The utilization energy is technology resource. A nations are world, Canada relatively developed type in provide the in development sites with p been located the Northw have possibl could be u analysis. Some data presently u to 10 percent could be s year 2000. W78-03845

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WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

Effects On Water Of Man's Non-Water Activities—Group 4C

Groundwater recharge, Seepage, Planning, Aquifers, Alluvial aquifers, *India, Inadequate data.

Preparation and execution of plans and schemes for the exploitation of groundwater cannot be held over till the completion of studies which may take four to five years. Therefore, it has become necessary to adopt some reasonably accurate methodology to evaluate the groundwater potential with the help of the available data and to plan groundwater exploitation projects on its basis, keeping margin for subsequent adjustments when better data become available. Appraisal techniques and adopted criteria for an approximate evaluation of groundwater balance in water table aquifers were described, with particular reference to the Bist Doab Tract of the State of Punjab-India which has an area of 9,000 sq km and where 90% of annual rainfall occurs July to September. A significant part of the assessment study is the recharge to groundwater from the annual flow of about 1.25 million acre feet of surface water through network of unlined and lined irrigation canals and its ultimate spillage in the cropped fields. On the discharge side is the withdrawal by approximately 0.1 million existing shallow and deep water wells. (See also W78-03783) (Humphreys-ISWS)
W78-03799

PROSPECTS FOR GEOTHERMAL ENERGY APPLICATIONS AND UTILIZATION IN CANADA,

Toronto Univ. (Ontario). Inst. for Aerospace Studies.

L.I. Glass.
Energy, Vol. 2, No. 4, p 407-428, December, 1977. 11 fig, 5 tab, 94 ref, 2 append.

Descriptors: *Thermal power, *Geothermal studies, Thermal waters, Hot springs, Steam, Nuclear explosions, Fractures(Geology), Electric power production, Exploration, Economics, Environmental effects, *Canada, Hot dry rock, Hydraulic fracturing, Explosive fracturing, Nuclear fracturing.

The utilization of the vast reserves of geothermal energy is still in its infancy, however, future technology may well lead to greater access of this resource. Although significant geothermal installations are already in operation throughout the world, Canadian development in this area has been relatively dormant. The problem areas are not of technological nature but rather of an institutional type in passing a geothermal act that would provide the incentives for exploration and economical development. A small number of thermal spring sites with potential for geothermal utilization have been located in British Columbia, the Yukon, and the Northwest Territories. Other provinces may have possible hot-water and hot-dry-rock sites that could be used, but a great deal of exploration and analysis need to be done to locate these resources. Some detailed and worthwhile investigations are presently under way at a low key. It is hoped that 5 to 10 percent of the total Canadian energy need could be supplied by geothermal sources by the year 2000. (Eberle-NWWA)
W78-03845

1977 REVIEW, 1978 PREVIEW.

Ground Water Age, Vol. 12, No. 4, p 24-25, December, 1977. 1 tab.

Descriptors: *Water wells, *Drilling, *Economic prediction, Capital costs, Expenditures, Employment, Profits, Personnel, Inflation(Economic).

The results of a national survey of well drilling contractors recently completed by Ground Water Age reflect moderate optimism that 1978 will be a good year for the well industry in most economic respects. The three hundred respondents were selected on a random sample, population-weighted

basis from twelve key states. Their opinions on fourteen key economic factors are presented in tabular form. Although the majority of contractors expect little or no improvement in national economy problems such as inflation and unemployment, some increase is predicted for gross sales, net sales, gross and net profits, and capital expenditures. Despite a continued high rate of business booking cancellations and bad debts over the past two years, the market for new wells is favorable. Better cost control systems throughout the well industry also are helping to offset miscellaneous losses. (Eberle-NWWA)
W78-03848

PRELIMINARY ASSESSMENT OF A GEOTHERMAL ENERGY RESERVOIR FORMED BY HYDRAULIC FRACTURING,

Los Alamos Scientific Lab., NM.

For primary bibliographic entry see Field 8B.
W78-03853

GROUND-WATER POLLUTION PROBLEMS IN THE SOUTHEASTERN UNITED STATES,

Geraghty and Miller, Inc., Port Washington, NY.

For primary bibliographic entry see Field 5B.
W78-03856

ENVIRONMENTAL ASSESSMENT OF GEOPRESSED WATERS AND THEIR PROJECTED USES,

Dow Chemical U. S. A., Freeport, TX. Texas Div. J. S. Wilson, J. R. Hamilton, J. A. Manning, and P. E. Muehlberg.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-268 289, Price codes: A05 in paper copy, A01 in microfiche. Report No. EPA-600/7-77-039, April, 1977. 97 p, 11 fig, 10 tab, 59 ref.

Descriptors: *Geothermal studies, *Thermal power, Thermal water, Natural gas, Faults(Geology), Environmental effects, Economics, Electric power production, Water pollution sources, Air pollution, Land subsidence, Injection wells, Waste water disposal, Equipment, Cooling towers, Heating, Earthquakes, Texas, Louisiana, *Geopressed zones, Gulf Coast.

This report considers the potential uses of the geopressed geothermal resources of Texas and Louisiana and the environmental aspects of those uses. Principal environmental impacts of any of the proposed uses will result from the waste fluid streams and from possible subsidence of the field. Though waste water of very low salinity may possibly have agricultural applications, reinjection of spent brine or canaling to a saline water body will be required in most cases. Development of the Gulf Coast geothermal resource appears to be from 5 to 15 years in the future, depending upon energy priorities assigned to the area by the U. S. Government; private development, because of the risk involved, must await government proving of the resource. Exhaustive environmental surveys to assess the present environmental quality of the Texas-Louisiana geopressed area will eventually need to be performed as well as thorough study of the potential for pollution from various phases of energy production and the possibilities of accelerated subsidence and increased seismic activity. In view of the uncertainty about such energy development and the long time frame involved, only moderate emphasis on environmental research is required at this time. (Eberle-NWWA)
W78-03857

EVALUATION OF SCINTILLATION PROBE PROFILES FROM 200 AREA CRIB MONITORING WELLS,

Atlantic Richfield Hanford Co., Richland, WA. Research Dept.

For primary bibliographic entry see Field 5B.
W78-03860

DRILLING FOR ENERGY RESOURCES.

National Research Council, Washington, DC. Ad Hoc Committee on Technology of Drilling for Energy Resources.

For primary bibliographic entry see Field 8C.
W78-03861

DEVELOPMENT OF AN ASSESSMENT METHODOLOGY FOR GEOPRESSED ZONES OF THE UPPER GULF COAST BASED ON A STUDY OF ABNORMALLY PRESSURED FIELDS IN SOUTH TEXAS,

Southwest Research Inst., San Antonio, TX.

For primary bibliographic entry see Field 8B.
W78-03863

THE REPORT TO CONGRESS: WASTE DISPOSAL PRACTICES AND THEIR EFFECTS ON GROUND WATER: EXECUTIVE SUMMARY.

Environmental Protection Agency, Washington, DC. Office of Water Supply.

For primary bibliographic entry see Field 5B.
W78-03864

SUITABILITY OF FLUOROCARBONS AS TRACERS IN GROUND WATER RESOURCES EVALUATION,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 5A.
W78-03967

THE SELF-PURIFICATION OF UNDERGROUND WATERS, (IN RUSSIAN),

Belorussian Sanitary-Hygienic Research Inst., Minsk (USSR).

For primary bibliographic entry see Field 5B.
W78-04076

GROUNDWATER ANALYSIS BY TRITIUM TECHNIQUE: A PRELIMINARY EVALUATION,

Guam Univ., Agana. Water Resources Research Center.

For primary bibliographic entry see Field 2F.
W78-04100

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF URBANIZATION ON FLOOD CHARACTERISTICS IN NASHVILLE-DAVIDSON COUNTY, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.

H. C. Wibben.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 654, Price codes: A03 in paper copy, A01 in microfiche. Water-Resources Investigations 76-121, 1976. 33 p, 12 fig, 4 tab, 14 ref.

Descriptors: *Urbanization, Effects, *Rainfall-runoff relationships, *Flood discharge, *Peak discharge, Flood forecasting, *Tennessee, Streamflow, Flow rates, Analytical techniques, Regression analysis, Estimating equations, Model studies, Davidson County(Tenn), *Nashville(Tenn).

Streamflow data from 14 basins in Davidson County, Tenn., were extended in time by use of a digital model of the hydrologic system. The basins ranged in size from 1.58 to 64.0 square miles and ranged in extent of manmade impervious cover from 3 to 37 percent. The flood-frequency characteristics were defined by weighting frequency curves based on simulated discharges with those

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4C—Effects On Water Of Man's Non-Water Activities

based on observed discharges. The average record length of the three rain gages used in simulation was 72 years, and the average record length of observed discharges was 11 years. Discharges corresponding to 2-, 5-, 10-, 25-, 50-, 100-year floods from the modeled basins were compared with discharges from regional equations for estimating peak discharge rates from rural basins. Basin lag times of the urban basins were compared with those of nearby rural basins. The analyses indicated that in a fully-developed residential area, the flood peaks and the basin lag times will not be significantly different from those expected from an undeveloped area. Data were not sufficient to determine if an increase in flood peaks would occur from extremely small basins with extremely intensive development. (Woodard-USGS) W78-03766

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME I. EVALUATION OF RECREATION USE SURVEY PROCEDURES,
Army Engineer District, Sacramento, CA.
For primary bibliographic entry see Field 6B.
W78-03891

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME III. A PRELIMINARY ANALYSIS OF DAY USE RECREATION AND BENEFIT ESTIMATION MODELS FOR SELECTED RESERVOIRS,
Army Engineer District, Sacramento, CA.

R. E. Brown, and W. J. Hansen.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-000 650, Price codes: A05 in paper copy, A01 in microfiche. Prepared for Institute for Water Resources (Army), Washington, D.C., June 1974. 69 p, 6 tab, 21 fig, 3 append.

Descriptors: *Recreation, *Recreation demand, *Reservoirs, *Regression analysis, *Methodology, Economics, Recreation facilities, Cost-benefit analysis, Model studies, Estimating, Analytical techniques, Approximation method, Estimating equations, Projections, Statistical methods, *Fort Worth Army Engineer District, *Sacramento Army Engineer District, *Travel cost model, Travel costs.

This report presents a methodology for estimating recreation use and recreation benefits at existing and proposed Corps of Engineers reservoirs. It is the outgrowth of recreation use studies instituted by the Office of the Chief of Engineers. Multiple linear regression analysis is employed to develop two regional day use estimating models from recreation use survey data collected at 19 Corps reservoirs in the Fort Worth and Sacramento Army Engineer Districts. The estimators developed should be applicable for estimating day use at most existing or proposed Corps reservoirs within these regions. A number of studies have reported techniques for estimating recreation benefits; the majority of these endorse a general approach known as the travel cost model. This approach uses variable or out-of-pocket travel costs as the proxy for price to construct demand schedules for estimating recreation benefits. Although these studies have demonstrated the technique and produced demand schedules for existing sites, they do not yield a general model from which a planner can estimate benefits for a wide range of proposed projects within a region. The methodology presented in this study is of considerably greater scope and intensity than other estimating procedures in current use and yields reasonable and useful results. There should be further improvements and refinements to the technique as additional recreation use data are collected and analyzed. This report is one of five volumes in this series of studies. (See also W78-03891) (Nessa-NC)
W78-03893

SNOW MECHANICS SYMPOSIUM.
International Association of Scientific Hydrology, Gentbrugge (Belgium).
For primary bibliographic entry see Field 2C.
W78-03998

THE EFFECTS OF WOOD DEBRIS AND DRIFT LOGS ON ESTUARINE BEACHES OF NORTHERN PUGET SOUND,
Western Washington State Coll., Bellingham, Dept. of Geography and Regional Planning.
For primary bibliographic entry see Field 2L.
W78-04103

PALAEOECOLOGICAL STUDIES OF THE RECENT DEVELOPMENT OF LAKE VAX-JOSON II. SETTLEMENT AND LANDSCAPE DEVELOPMENT,
Kvarterbiologiska Labs, Lund (Sweden).
For primary bibliographic entry see Field 5C.
W78-04152

THE EFFECT OF ROAD DEICING SALT ON THE DRIFT OF STREAM BENTHOS,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W78-04196

4D. Watershed Protection

APPLICATION OF COUTAGNE'S AND TURC FORMULAS TO THE SOUTHERN MOZAMBIQUE RIVERS,
Royal Irrigation Dept., Bangkok (Thailand). Hydrology Div.
For primary bibliographic entry see Field 4A.
W78-03789

PRACTICES OF DESIGN FLOOD FREQUENCY FOR SMALL WATERSHEDS IN THAILAND,
Royal Irrigation Dept., Bangkok (Thailand). Hydrology Div.
For primary bibliographic entry see Field 4A.
W78-03806

A METHOD FOR THE PREDICTION OF WASHLOAD IN CERTAIN SMALL WATERSHEDS,
O. Rendon-Herrero.

In: Design of Water Resources Projects with Inadequate Data, Volume 2; Proceedings of the Madrid Symposium June 1973; International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 589-602, 1974. 6 fig, 1 tab, 9 ref.

Descriptors: *Suspended load, *Sediment discharge, *Forecasting, *Small watersheds, *Pennsylvania, Hydrographs, Analytical techniques, Methodology, Analysis, Sediments, Runoff, Sediment transport, Hydrograph analysis, Discharge(Water), Erosion, Unit hydrographs, *Bixler Run Watershed(PA), Sedimentograph.

Present knowledge on the prediction of washload reveals that with the exception of the universal soil loss equation and sediment-rating techniques, a rational method does not exist that can accomplish the task. A method was presented that is analogous to Sherman's unit-hydrograph method of hydrograph analysis. The method was described as follows: The ordinates of a sediment discharge graph are divided by the excess runoff that mobilized it, producing a unit sediment discharge graph. When this is done for many storm events, unit sediment discharge graphs are generated that vary considerably in peak value and shape. The ordinates of the latter graphs are then plotted logarithmically against their respective excess runoff, yielding data points that can be fitted by straight lines. Predictions of sediment discharge or the generation of a sediment discharge graph for a given excess runoff can be accomplished using the resulting graph. Bixler Run Watershed, Pennsylvania, having a drainage area of 15 square miles, was selected as a data source. Granulometric tests and other related information disclosed that the suspended sediment in Bixler Run is predominantly washload. Prediction of washload utilizing the proposed method yielded errors that were considerably less than the method reported using available sediment transport formulas and techniques. (See also W78-03783) (Humphreys-ISWS)

W78-03810

TURBIDITY AND SEDIMENT-RATING CURVES FOR STREAMS ON OAHU, HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2J.
W78-03931

URBAN FLOOD WATER MANAGEMENT SYSTEMS IN SEMIARID REGIONS: MODEL EXTENSION, DESIGN AND APPLICATION,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 6A.
W78-03965

ECOLOGICAL LAND UNITS OF BEAR CREEK WATERSHED AND THEIR RELATIONSHIP TO WATER QUALITY,
Oregon State Univ., Corvallis. Water Resources Research Inst.

J. L. Mattison, and J. C. Buckhouse.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 823, Price codes: A07 in paper copy, A01 in microfiche. Report No. WRRI-53, September 1977. 122 p, 16 fig, 6 tab, 88 ref, 3 append. OWRT A-032-ORE(1), 14-34-0001-7078.

Descriptors: *Sedimentation, *Watershed management, Runoff, *Water quality, Soils data, Oregon, *Bear Creek watershed(Ore), *Ecology, Land management, *Terrestrial habitats, Factor analysis, Clear-cutting, *Sediment transport.

During 1975 and 1976 a sedimentation study was conducted in the Bear Creek watershed, located in the southeastern corner of central Oregon's Crook County. A Rocky Mountain infiltrometer was used to simulate high intensity rainfall over 468 sedimentation plots. Rainfall and runoff were measured and a sample of the runoff was collected to determine the sediment potentials. The Bear Creek watershed was divided into eight ecological land units which were further refined into 14 tentative habitat types and four unclassified communities. These divisions are based upon an association table developed from vegetation and soil field data. One- and two-factor analysis of variance was used to analyze the differences within habitat types, between habitat types within a unit, and when appropriate, between treatments or ecological condition within the habitat type or unit. Tractor logging in the mixed forest unit caused a significant increase in soil loss. Non-forest units exhibited a high natural variability in sediment production within the site which tended to override any differences that may have resulted from a management treatment. Significant differences that did occur appeared to be closely related to differences in soils or ecological condition. Wildland watershed managerial implications are explored in a summary section.
W78-04099

ANALYSIS OF INFORMATION SYSTEMS FOR HYDROPOWER OPERATIONS, - EXECUTIVE SUMMARY,
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 8C.
W78-04107

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY—A STRATEGY FOR BALANCED DEVELOPMENT AND PROTECTION OF WATER AND RELATED LAND RESOURCES IN EASTERN MASSACHUSETTS AND RHODE ISLAND.

New England River Basins Commission, Boston, MA.

For primary bibliographic entry see Field 6B.
W78-04146

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

ARSENIC CONTENT AND ITS SEASONAL VARIATION IN SEAWEED, (IN JAPANESE), Shimonoseki Univ. of Fisheries (Japan).

S. Tagawa, and Y. Kojima.

The Journal of the Shimonoseki University of Fisheries, Vol 25, No 1, p 67-74, 1976. 6 tab, 21 ref.

Descriptors: *Pollutant identification, Aquatic plants, *Aquatic weeds, *Seasonal, *Marine plants, *Arsenic compounds, *Colorimetry, Analytical techniques, Distribution, Chemical analysis, Sampling, Productivity, Growth theory, Public health, *Seaweed, Bioaccumulation, Tissue analysis, *Sargassum thunbergii*, *Hijikia fusiforme*, Green seaweed, Red seaweed.

Seaweeds were analyzed colorimetrically for arsenic by arsine-silver diethyldithiocarbamate-brucine-chloroform system, after being digested with a mixture of nitric and sulfuric acids. The range of arsenic content was from below 1 to 8 microg/g for green seaweed, from below 1 to 12 microg/g for red seaweed. The brown seaweed contained more arsenic than green and red seaweeds. The seaweeds of *Sargassaceae* concentrated arsenic highly and the average content of arsenic in 7 species of the family was 61 plus or minus 19 microg/g. The arsenic content of 11 specimens of *Sargassum thunbergii* collected from the same place on the same day varied respectively with an average value of 142 plus or minus 48 microg/g. The arsenic content of upper, middle and lower parts of the following two species was determined. Significant differences were detectable in the parts in *Hijikia fusiforme* but not in *S. thunbergii*. A greater amount of arsenic was contained in leaves than in stems of *H. fusiforme*. Specimens of the above two species were analysed, which were collected from the same place approximately biweekly from October to July. The arsenic content of *H. fusiforme* did not vary so much from Oct. to May with an average value of 60 plus or minus 11 microg/g, but subsequently increased with maturation, reaching a maximum value of 141 microg/g in July. With *S. thunbergii*, the arsenic content was on a level similar to that of *H. fusiforme* in Oct., and increased with growth, keeping a higher level of 154 plus or minus 30 microg/g from Jan. to July. (Klein)
W78-03712

HEAVY METALS, SELENIUM AND ARSENIC IN NINE SPECIES OF AUSTRALIAN COMMERCIAL FISH,

New South Wales Dept. of Fisheries, Sydney (Australia).

G. N. Bebbington, N. J. MacKay, R. Chovjka, R. J. Williams, and A. Dunn.

Australian Journal of Marine and Freshwater Research, Vol 28, p 277-286, 1977. 2 tab, 23 ref.

Descriptors: *Metals, *Heavy metals, *Fish physiology, *Arsenic compounds, *Path of pollutants, *Marine fish, Metabolism, Cadmium, *Mercury, Lead, Copper, Zinc, Toxicity, Safety, Sampling, Analytical techniques, Salmon, Mussels, Australia, Commercial fishing, Public health,

*Selenium, Tissue analysis, Bioaccumulation, Bream, Snapper, Mulloway, Kingfish, Australian salmon, Yellowfin tuna, Sea mullet, Flathead, Tailor.

Of the 232 fish analysed, 231 had concentrations of cadmium, lead, copper, and zinc below the National Health and Medical Research Council (NHMRC) standards for these elements in foodstuffs. Several specimens of bream, snapper, muloway, kingfish, Australian salmon, and yellowfin tuna had total mercury concentrations in excess of the NHMRC standard of 0.5 ppm. These fish accounted for approximately 7% of the total number sampled. None of the sea mullet, flathead, and tailor sampled exceeded the standard for mercury. The mercury in all species sampled occurred almost entirely as methyl mercury. Of the 95 fish analysed for arsenic and selenium, 20 fish (21%) had arsenic concentrations equal to or greater than the NHMRC standard for selenium. The health risks associated with the presence of mercury and arsenic in these species were discussed. (Klein)
W78-03713

RAPID BIOASSAY FOR WATER SOLUBLE FUNGITOXICANTS,

Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.

G. E. Ernst.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A030 521, Price codes: A02 in paper copy, A01 in microfiche. Army Mobility Equipment, Report 2182, June 1976, 12p, 4 tab, 5 ref.

Descriptors: *Toxicity, *Bioassay, *Laboratory tests, Fungi, Aquatic plants, Fungicides, Biochemistry, Physiology, *Phenols, Organic compounds, Water pollution effects, Methodology, *Phenols, Pollutant identification, *Candida, Dowicide, *Chlorinated phenols, *Pentachlorophenol.

A screening method for water soluble fungitoxins was developed which gives results within a day. The test method is based on the fault of *Candida albicans* to form germination tubes within 3 to 6 hours' incubation in certain growth promoting media. (Katz)
W78-03716

ACUTE AND CHRONIC PARATHION TOXICITY TO FISH AND INVERTEBRATES,

Environmental Research Lab., Duluth, MN.

For primary bibliographic entry see Field 5C.

W78-03718

BASELINE STUDY OF TRACE HEAVY METALS IN BIOTA OF PUGET SOUND,

Washington Univ., Seattle. Coll. of Fisheries.

S. J. Olsen, and W. R. Schell.

Municipality of Metropolitan Seattle, Puget Sound Research, April 1977, 66 p, 27 fig, 7 tab, 94 ref. CR-2164.

Descriptors: *Metals, *Baseline studies, *Heavy metals, *Trace elements, Analytical techniques, Mussels, Marine fish, Phaeophyta, Sampling, Water quality, Demersal fish, Mercury, Lead, Cadmium, Cobalt, Copper, Chromium, Zinc, Arsenic compounds, Bioindicators, Water pollution sources, Municipal wastes, Washington, *Puget Sound, Cerium, Silver, Antimony, Selenium, *Mytilus edulis*, *Parophrys vetulus*, English sole, *Fucus sp.*, Bioaccumulation, Tissue analysis.

Forty-six species of biological organisms (plankton, molluscs, echinoderms, crustacea, algae, and fish) were collected from Puget Sound and analyzed for as many as twelve trace heavy metals: Mercury, lead, cadmium, cobalt, copper, cerium, selenium, chromium, silver, zinc, arsenic, and antimony. Discussions of the sampling program, analytical procedures, special techniques to

minimize contamination, and quality control were detailed. Included in the results of this study were accumulation patterns, concentration factors, possible biological pathways, and identification of indicator species. Correlations were found between concentrations of several metals in samples and Metro's sewage outfalls, from which these metals came. The sources of heavy metals were indicated by the concentrations found in *Fucus sp.* (brown algae) for Cu, Co, and Zn; in *Mytilus edulis* (bay mussel) for Pb, Zn, Cr, Cu, Se, Ce, and As; and in the organs of *Parophrys vetulus* (English sole) for Pb, Cd, and Cu. All trace heavy metal concentrations in the biota of Puget Sound were below accepted toxicity guidelines. (Klein)
W78-03719

THE DIFFERENTIAL EFFECTS OF FREE AND COMBINED CHLORINE ON JUVENILE MARINE FISH,

Woods Hole Oceanographic Institution, MA.

For primary bibliographic entry see Field 5C.

W78-03729

CHRONIC ORAL TOXICITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD) TO RAINBOW TROUT,

Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forest Services Lab.

For primary bibliographic entry see Field 5C.

W78-03733

DETERMINATION OF TRACE AMOUNTS OF METHYLMERCURY IN SEA WATER,

Kumamoto Univ., (Japan). Dept. of Industrial Chemistry.

H. Egawa, and S. Tajima.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan, EPA-600/3-77-083, July 1977, p 96-106. 4 ref, 8 fig, 2 tab.

Descriptors: *Methodology, *Pollutant identification, *Mercury, *Water analysis, *Chelation, *Chemical analysis, *Separation techniques, Adsorption, Water pollution sources, Pollutants, Toxins, Organic compounds, Measurements, *Methylmercury, *Macroreticular chelating resin.

The use of chelating resins for determining the concentration of methylmercury in seawater is investigated. Macroreticular chelating resin containing episulfide groups was excellent for both adsorption on methylmercury and the elution of it with hydrochloric acid. The adsorption of methylmercury on the resin attained equilibrium after shaking for 12 hours at 30°C. The calibration curve of methylmercury added to deionized water, synthetic seawater and natural sea water had excellent linearity in the concentration range of 0.005 microg/liter to 0.05 microg/l and it was only slightly affected by mercuric ions and other various ions in seawater. (See also W78-03735) (Katz)
W78-03740

ROTIFER SENSITIVITY TO COMBINATIONS OF INORGANIC WATER POLLUTANTS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies; and Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

For primary bibliographic entry see Field 5C.

W78-03754

DISCHARGE AND WATER-QUALITY DATA FOR SELECTED STREAMS AT LOW FLOW INCLUDING SOME BOTTOM-MATERIAL ANALYSES, AND LIMNOLOGICAL STUDY OF SIX LAKES, WESTCHESTER COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.

For primary bibliographic entry see Field 5B.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

W78-03758

PHYSICAL, CHEMICAL, AND BIOLOGICAL RELATIONS OF FOUR PONDS IN THE HIDDEN WATER CREEK STRIP-MINE AREA, POWDER RIVER BASIN, WYOMING,
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W78-03763

DISTRIBUTION AND ABUNDANCE OF BENTHIC ORGANISMS IN THE SACRAMENTO RIVER, CALIFORNIA.

Geological Survey, Menlo Park, CA. Water Resources Div.
R. F. Ferreira, and D. B. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 744, Price codes: A03 in paper copy, A01 in microfiche. Water-Resources Investigations 77-60, October 1977. 24 p, 3 fig, 5 tab, 13 ref.

Descriptors: *Water quality, *Data collections, *Analytical techniques, *Benthos, *Rivers, *California, Bottom sampling, Ecological distribution, Biological communities, *Sacramento River(Calif), Sacramento Valley.

General comparisons were made between benthic organism samples collected in 1960-61 and 1972-73 from five sites in the Sacramento River between Red Bluff and Knights Landing, Calif. The composition of benthic organisms from both collection periods was similar. The 1972-73 data showed variable patterns in monthly changes at each site and downstream changes each month with number of organisms per square meter, number of taxa per square meter, and diversity index. Generally, the mean number of taxa per square meter and diversity index for all sampling periods were higher in the upper reach than the lower reach of the Sacramento River. (Woodard-USGS)
W78-03773

ANALYSES OF NATIVE WATER AND DREDGED MATERIAL FROM SOUTHERN LOUISIANA WATERWAYS, 1975-76,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. R. Demas, and P. C. Higgins.
Open-file report 77-503, June 1977. 180 p, 18 plates, 17 tab, 9 ref.

Descriptors: *Chemical analysis, *Water analysis, *Bottom sediments, *Dredging, *Inland waterways, Louisiana, Water quality, Basic data collections, Navigable waters, Dissolved solids, Metals, Pesticides, Nutrients, Organic compounds, *Southern Louisiana waterways.

From June 1975 to July 1976 the U.S. Geological Survey conducted nine dredging and seven post-dredging studies related to water quality in selected reaches of major navigable waterways of southern Louisiana. Samples were collected from the Mississippi River-Gulf Outlet, Mississippi River at Southwest Pass, Mississippi River at New Orleans, Bayou Rigoard near Grand Isle, Barataria Bay and Waterway, Bayou La Carpe near Houma, Atchafalaya Bay (Ship Channel), Lower Atchafalaya River area, Intracoastal Waterway near Calumet, Intracoastal Waterway (Port Allen to Morgan City), Petite Anse area, and Calcasieu River and Ship Channel. These studies were conducted to determine potential environmental effects of dredging activities in the waterways. The Geological Survey collected, treated, and analyzed 383 water and water-sediment mixture samples from 85 dredging sites and 142 postdredging samples (72 sites). Water samples were collected 100 yards upstream and downstream from the dredge effluent, from the disposal area, and from the effluent outfall during the dredge phase of the study; samples were collected at former dredge sites dur-

ing the postdredging phase. Samples were analyzed for selected metals, pesticides, nutrients, and organic constituents. The analytical data are presented in tables. Sampling sites are shown on maps. (Woodard-USGS)
W78-03779

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1976.

Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03780

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 2. EASTERN WASHINGTON.

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03781

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 1. WESTERN WASHINGTON.

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W78-03782

DISSOLVED ORGANIC CARBON IN SOME DARK VENEZUELAN WATERS AND A REVISED EQUATION FOR SPECTROPHOTOMETRIC DETERMINATION OF DISSOLVED ORGANIC CARBON,
Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, Jr. and D. Canfield.
Archiv fur Hydrobiologie, Vol. 79, No. 4, p 441-445, 1977. 1 fig, 1 tab, 13 ref.

Descriptors: *Chromatography, *Spectrophotometry, *Venezuela, *Carrao River(Venezuela), *Guri Reservoir(Venezuela), *Dissolved organic carbon, Electrolytes, Tropical regions, Southeast U.S., *Pollutant identification.

Water samples from the Carrao River and the Guri Reservoir in Venezuela were analyzed for dissolved organic carbon by means of combustion/chromatography. Both water bodies were dark in color and very poor in electrolytes. The relation between absorbance of light at 360 nm and amount of dissolved organic carbon was found to be the same as for some dark waters in the Southeastern United States that were tested in an earlier study. A simple equation predicts dissolved organic carbon from absorbance and has equal validity for the temperate and tropical dark waters. The dark tropical waters thus seem to be qualitatively similar to dark waters of the temperate zone. Further study of the dark electrolyte-poor tropical waters should therefore be possible on the basis of spectrophotometry alone by use of the equation outlined in this study. (Coyle-Wisconsin)
W78-03819

S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO THE NEW YORK STATE WATER RESOURCES,

Calspan Corp., Buffalo, NY.
K. R. Piech, J. R. Schott, and K. M. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as N76-14564, Price codes: A03 in paper copy, A01 in microfiche. Calspan Corporation Report No. YB-5298-M-2, June 1975. 44 p, 12 fig, 4 tab, 14 ref. NAS9-13336.

Descriptors: *Pollutant identification, S190 system, *Skylab, *Lake Ontario, *Remote sensing, *Water quality indices, *Eutrophication, New York, Lakes, Conesus Lake(NY), Great Lakes, Satellites(Artificial), Reflectance, Aerial photography, Infrared radiation, IFYGL.

Blue and green lake reflectances determined from Skylab S190A color images of Lake Ontario and Conesus Lake, New York were successfully correlated with key water quality indices, such as photic zone depth, Secchi disk transparency, attenuation coefficient, and chlorophyll concentration. Satellite, aircraft, and surface vessel data were used in this study. The blue to green reflectance ratio is inversely proportional to chlorophyll concentration, does not vary with humic acid, and is directly proportional to the amount of lignin. Green and red reflectances are directly proportional to both chlorophyll and lignin, the green reflectance is inversely proportional to humic acid, and the red reflectance is unchanged by humic acid. Increased resolution of the S190 system would greatly enhance the accuracy of data processing; at present the resolution enabled removal of atmospheric effects which account for about two-thirds of the radiance at the spacecraft. Increased resolution would permit use of the shadow calibration process used in aircraft eutrophication studies, which is not only more accurate, but can be applied to a larger number of areas surrounding the lake. Data from infrared spectral imagery was used to detect atmospheric variations and account for them in processing data from key visible spectral regions related to the eutrophication indices. (Lynch-Wisconsin)
W78-03822

INSECTICIDE AND NUTRIENT TRANSPORT IN WATER, RELATED TO AGRICULTURAL LAND USE OF A STREAM BASIN IN ONTARIO, CANADA,

Department of Agriculture, London (Ontario). Research Inst.
For primary bibliographic entry see Field 5B.
W78-03823

CHLORIDE AND NITROGEN CONCENTRATIONS ALONG THE WEST SHORE OF LAKE ERIE,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5B.
W78-03826

ATMOSPHERIC INPUT OF PHOSPHORUS TO SOUTHERN LAKE HURON, APRIL-OCTOBER, 1975,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5B.
W78-03828

THE CHEMICAL COMPOSITION OF CENTRAL AMAZONIAN AQUATIC MACROPHYTES WITH SPECIAL REFERENCE TO THEIR ROLE IN THE ECOSYSTEM,

Max-Planck-Instit. fuer Limnologie zu Plön (West Germany).
For primary bibliographic entry see Field 5C.
W78-03831

DISSOLVED ORGANIC MATTER IN LAKE-WATER: CHARACTERISTICS OF MOLECULAR WEIGHT SIZE-FRACTIONS AND ECOLOGICAL IMPLICATIONS,

Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W78-03833

INFLUENCE OF LOW TEMPERATURES ON THE SURVIVABILITY OF SELECTED SPECIES OF ALGAE,

Institutum Zootechniki, Zator (Poland).
For primary bibliographic entry see Field 5C.
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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

EVALUATION BY BIOASSAYS OF THE TOXICITY TO FISH OF SUGAR FACTORY AFFECTS,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology-Entomology.
For primary bibliographic entry see Field 5C.
W78-03836

BACTERIOLOGICAL SURVEY OF TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 5C.
W78-03840

REMOVING H₂S FROM GEOTHERMAL STEAM,
Court and Associates, Inc., Lakewood, CO.
For primary bibliographic entry see Field 5G.
W78-03855

A PROCEDURE FOR DETECTION AND MEASUREMENT OF INTERFACES IN REMOTELY ACQUIRED DATA USING A DIGITAL COMPUTER,
National Aeronautics and Space Administration, Houston, TX. Lyndon B. Johnson Space Center.
For primary bibliographic entry see Field 7B.
W78-03865

REMOTE SENSING OF OIL POLLUTION AT THE SEA SURFACE I. REVIEW OF REMOTE SENSING METHODS EMPHASIZING RADAR,
Netherlands Interdepartmental Working Group on the Application of Remote Sensing, Delft.
J. van Kuilenburg.

Available from the National Technical Information Service, Springfield, VA 22161 as N77-23582, Price codes: A03 in paper copy, A01 in microfiche. NIWARS Report, July 1975. 30 p., 18 fig, 12 tab, 45 ref.

Descriptors: *Remote sensing, *Oil pollution, *Radar, Monitoring, *Pollutant identification, *Outer Continental Shelf, Sea surface, Oil slicks.

The problem of monitoring oil pollution is stated and the remote sensing methods applicable for that purpose are reviewed. A more detailed discussion is presented on radar observations of oil slicks and of the surrounding sea surface. A selected bibliography is presented. (See also W78-03868) (Sinha - OEIS)
W78-03867

REMOTE SENSING OF OIL POLLUTION AT THE SEA SURFACE II. DAMPING OF WATER WAVES BY AN OIL LAYER AS A POSSIBLE INDICATOR FOR SOLAR OBSERVATIONS,
Netherlands Interdepartmental Working Group for the Application of Remote Sensing Techniques, Delft.

A. C. Pronk.
Available from the National Technical Information Service, Springfield, VA 22161 as N77-23583, Price codes: A02 in paper copy, A01 in microfiche. NIWARS Publication No. 22, July 1975. 13 p., 7 fig, 21 ref.

Descriptors: *Remote sensing, *Oil pollution, *Waves(Water), Water pollution, *Pollutant identification, *Outer Continental Shelf, Damping.

The damping action of oil pollution on sea-waves is discussed in view of observation from the air. It is found that oil layers of all thicknesses damp a part of the wave-spectrum. Only in case of thicker layers is the damping related to the nature of the oil. The distance over which the sea-waves damp out after an oil slick has entered seems a useful indicator for the oil properties. (See also W78-03867) (Sinha - OEIS)
W78-03868

ANALYSIS OF MICROGRAM/KG (PPB) LEVEL HYDROCARBONS IN INTERTIDAL ZONE SEDIMENTS AND WATER BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
National Bureau of Standards, Washington, DC. Bioorganic Standards Section.
H. S. Hertz, W. E. May, S. N. Chesler, and B. H. Gump.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 922, Price codes: A02 in paper copy, A01 in microfiche. Reprinted from: Proceedings of 23rd Annual Conference on Mass Spectrometry and Allied Topics, held Houston, TX on May 25-30, 1975. p 663-665, 1975. 2 fig, 1 ref.

Descriptors: *Pollutant identification, *Gas chromatography, Intertidal areas, Water pollution sources, *Baseline studies, Oil pollution, Analytical techniques, *Sediments, *Mass spectrometry, Hydrocarbons.

The low concentration of hydrocarbons anticipated in pollution baseline studies necessitates the development of analytical techniques sensitive at the sub-microgram/kilogram level. Techniques which involve dynamic headspace sampling and subsequent GC/GC-MS analysis have been developed in the laboratory. Sample components are separated from the matrix in a closed system and concentrated on a porous polymer pre-column, free from large amounts of solvent and ready for GC-MS analysis. Applications of this methodology to the identification of microgram/kilogram level hydrocarbons in a baseline study are discussed. (Sinha - OEIS)
W78-03869

THE STATE OF METAL IONS IN SEAWATER,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A028 703, Price codes: A03 in paper copy, A01 in microfiche. Reprinted from: Thalassia Jugoslavica, Vol 11, No 1/2, p 53-84, 1975. 14 fig, 9 tab, 75 ref.

Descriptors: Pollutant identification, Metal ions, *Heavy metals, *Ions, Metals, Sea water, Thermodynamics, Ion exchange.

The methods of determining the state or structure of metal ions in seawater are examined in terms of ion-water and ion-ion interactions. The ion-water interactions are related to the changes that occur when an ion is transferred from the gas to the infinite dilution solution state. The experimental thermodynamic properties at infinite dilution solution state. The experimental thermodynamic properties at infinite dilution are compared to the values determined using the continuum model and a structural hydration model. The hydration model considers the ion-water interactions in terms of ion-dipole, ion-quadrupole interactions and water structure effects. By combining partial molal volume and compressibility data a method is developed to determine hydration numbers for the major sea salts and some trace metal ions. The ion-ion interactions that occur as the concentrations are increased are examined by using three methods: (1) the ion pairing model, (2) the specific interaction model, and (3) the cluster (or non-specific interaction) model. For the major sea salts all the methods yield reasonable estimates for total or stoichiometric activity coefficients. The use of the ion pairing model for determining the speciation of heavy metals in seawater are examined and briefly discussed. Methods of studying the structure of ion paired species are developed and applied. (Sinha - OEIS)
W78-03870

SOLUTION CHEMISTRY, SOLUBILITY, AND ADSORPTION EQUILIBRIA OF IRON,

COBALT, AND COPPER IN MARINE SYSTEMS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.

D. R. Kester, T. P. O'Connor, and R. H. Byrne, Jr. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A030 834, Price codes: A02 in paper copy, A01 in microfiche. Reprinted from: Thalassia Jugoslavica, Vol 11, No 1/2, p 121-134, 1975. 7 fig, 1 tab, 17 ref. ONR-N00014-68-A-0215-0003.

Descriptors: *Iron, *Cobalt, *Copper, *Pollutant identification, Metals, Water pollution, Sea water, Outer Continental Shelf.

The stability constants for the formation of FeOH_2^+ complexes have been determined at an ionic strength of 0.68, and measurements in natural seawater verify the application of these constants to marine systems. The solubility of freshly precipitated hydrous ferric oxide was determined in natural seawater over the pH range 4.0 to 9.5. The results of this work were applied to consideration of the chemical forms of iron over the range of Eh and pH found in natural systems. The adsorption of Cu^{2+} and Co^{2+} onto illite and other substrates has been investigated and a model was developed to account for the adsorption equilibria of these metals as a function of pH for natural systems ranging from river water to oceanic waters. The application of these results to man-induced chemical changes in the marine environment is frequently limited by the lack of necessary information such as redox conditions, distinction between soluble and particulate phases, and the presence of complexing ligands. (Sinha - OEIS)
W78-03871

DEVELOPMENT OF A NEW DETECTOR FOR OIL IN WATER,
Naval Air Propulsion Test Center, Trenton, NJ. Fuels Div.

P. T. Thyrum.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A036 367, Price codes: A02 in paper copy, A01 in microfiche. Report No. NAPTC-PE-51, February 1975. 15 p., 3 fig, 1 tab, 7 ref.

Descriptors: *Monitoring, *Pollutant identification, *Oil pollution, Water pollution sources, Testing procedures, Filters, Equipment, Outer Continental Shelf.

A need for a sensitive, rapid and simple method for the determination of oil in water resulted in a research effort which led to the development of a new approach to the analysis of oil in water. A new detector, designed for shipboard use, was developed. The detector can be used for the quantitative analysis of undissolved particulate oil present in water over a zero to 30 parts per million concentration range. The method is not sensitive to dissolved oils and the measurements are not influenced by the presence of surfactants which are often found in bilge water. The method is rapid and can be performed by non-technical personnel. The final readout may be obtained either by simple visual color intensity matching or by means of a reflectance meter. The details of the material, apparatus and operations of the test procedure are described. (Sinha - OEIS)
W78-03876

PRELIMINARY REPORT ON IN SITU MEASUREMENTS OF THE EFFECTS OF SEWAGE DISCHARGE FROM NAVY SHIPS OPERATING WITHIN THE 12-MILE LIMIT,
Naval Ship Research and Development Center Bethesda, MD.

For primary bibliographic entry see Field 5E.
W78-03877

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

RESUSPENDED SEDIMENT ELUTRIATE STUDIES ON THE NORTHERN ANCHOVY, University of Southern California, Los Angeles. Allan Hancock Foundation. G. D. Brewer.

In: 'Marine Studies of San Pedro Bay, California, Part II', June 1976, p. 15-32, 1 fig, 6 tab, 15 ref.

Descriptors: *Water pollution, *Heavy metals, *Pesticides, *Toxicity, Pollutant identification, Dredging, Mortality, Anchovy, *Engraulis mordax*.

Samples of sediment from three locations in the Los Angeles-Long Beach Harbors and elutriates resulting from resuspension were assayed for heavy metals, pesticides, and other pollutants. Juvenile and adult northern anchovy (*Engraulis mordax*) were exposed to sediment elutriates prepared from seawater-sediment ratios between 4:1 and 100:1 for periods up to fourteen days. Toxicity varied between the three sediment samples; acute oxygen depletion was suspected as the cause of mortality. Analyses of muscle, gonad, gill, and liver tissues for silver, cadmium, chromium, copper, iron, manganese, nickel, lead and zinc from control and elutriate-exposed fish showed high levels of cadmium and zinc in fish exposed to the resuspended sediments. However, the small sample size precludes any conclusions regarding the rapid uptake of heavy metals. Sediment elutriate which had been stored for two weeks was not toxic to anchovy embryos and larvae. (See also W78-03882) (Sinha-OEIS)

W78-03884

BIOASSAY AND HEAVY METAL UPTAKE INVESTIGATIONS OF RESUSPENDED SEDIMENT ON TWO SPECIES OF POLYCHAETOUS ANNELIDS,

University of Southern California, Los Angeles. Allan Hancock Foundation.

For primary bibliographic entry see Field 5C. W78-03887

EFFECTS OF HYDROGEN SULFIDE ON FISH AND INVERTEBRATES PART I-ACUTE AND CHRONIC TOXICITY STUDIES,

Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries, and Wildlife.

For primary bibliographic entry see Field 5C. W78-03920

A CONTROLLED BIOASSAY SYSTEM FOR MEASURING TOXICITY OF HEAVY METALS, Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.

K. H. Mancy, and H. E. Allen.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 973, Price codes: A06 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-037, April 1977. 110 p, 8 tab, 19 fig, 95 ref.

Descriptors: *Methodology, *Laboratory tests, Laboratory equipment, *Bioassay, *Metals, *Toxicity, Copper, Fishes, Hydrogen ion concentration, Temperature, Conductivity, Calcium, *Alkalinity, Dissolved oxygen, Trace elements, *Pollutant identification, *Copper species, Metal micronutrients, *Metal toxicity, Metal oxidation state, Complexation, Design criteria, Fish bioassays, Anodic stripping, Voltammetry, Potentiometric membrane electrodes.

Biological availability of metal micronutrients and metal toxicity are believed to be dependent on metal oxidation state, complexation, and solubility as well as the physicochemical characteristics of the aqueous phase. Basic design criteria for fish bioassays which are capable of elucidating the dependency of toxicity on the type and concentration of various copper species were developed utilizing equilibrium chemical concepts and appropriate analytical techniques. In order to maintain a desired copper species in the bioassay medi-

um, synthetic waters were used under well-defined physical and chemical conditions. These solutions were synthesized in accordance with equilibrium models, which define the distribution of various copper species as a function of the solution physical and chemical characteristics. An experimental system was developed which permitted large volumes of the bioassay waters to be maintained at the desired chemical equilibria for the duration of the experiment. Monitoring of the bioassay system included measurements of (1) pH, (2) temperature, (3) flow, (4) specific conductance, (5) calcium, (6) total alkalinity, (7) dissolved oxygen, and (8) copper species. Novel analytical procedures were applied for the measurement and the differentiation of copper species. This included the use of anodic stripping voltammetry and potentiometric membrane electrodes. (Katz) W78-03926

DISSOLVED OXYGEN TEMPERATURE, SURVIVAL OF YOUNG FISH AT FISH SPAWNING SITES, North Dakota State Univ., Fargo. Dept. of Zoology.

For primary bibliographic entry see Field 5C. W78-03927

IDENTIFICATION OF ASBESTOS-MATERIALS IN SUSPENDED SOLIDS,

Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.

W. P. Bonner, R. B. Bustamante, H. W. Leimer, and J. T. Scardina.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 349, Price codes: A05 in paper copy, A01 in microfiche. College of Engineering, Completion Report No. 61, December 1977. 84 p, 27 fig, 9 tab, 21 ref. OWRT A-042-TENN(1), 14-34-0001-7089.

Descriptors: *Asbestos, *Asbestiform particles, Density gradient separations, Pollutant identification, Suspended solids, Separation techniques, Water pollution sources, Centrifugation, Scanning electron microscopy.

Objectives were to: (1) develop a method for the determination of asbestos in water using density gradient zonal centrifugation and scanning electron microscopy and (2) apply this technique to environmental samples collected in Tennessee. Evaluation of the technique included the use of clay minerals, quartz and several asbestos minerals in a density gradient having a density range of 2.0 to 2.9 g/cm³. Environmental samples (water) were collected upstream and downstream from known deposits of asbestos, entering and leaving water treatment plants, and upstream and downstream from major industrial areas. The data show that: (1) asbestiform particles can be separated from most of the masking materials found in natural waters by density zonal centrifugation, (2) chrysotile and amphibole type asbestos can be separated from each other by density gradient zonal centrifugation, (3) asbestos was found in water downstream from known deposits of asbestos, and (4) asbestiform particles which were probably introduced from man-made sources were found in the effluent of a sewage treatment plant. (Katz) W78-03934

SCIENTIFIC AND TECHNICAL ASSESSMENT REPORT ON VINYL CHLORIDE AND POLYVINYL CHLORIDE,

Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.

F. G. Huetter.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-249 461, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency, Report No. EPA-600/6-75-004, December 1975. 115 p, 2 fig, 55 tab, 205 ref.

Descriptors: *Toxicity, *Public health, *Air pollution, Pathology, *Toxins, Mortality, *Water pollution, Human pathology, *Human diseases, *Lethal limit, Chemical industry, *Chlorides, Path of pollutants, Water pollution sources, Industrial wastes, *Polyvinyl chloride, Carcinogens, Angiosarcoma, Mutagens, *Vinyl chloride, Teratogens.

Vinyl chloride (VC) is a chemical of widespread industrial and commercial use. Occupational experience and experimental evidence strongly indicate that it is a carcinogen. Additionally, there is experimental evidence that indicates that it may be a teratogen and mutagen. An increased incidence of liver angiosarcoma, excessive liver damage, and acroosteolysis has been reported among VC workers, and the frequency and severity of the liver pathology is related to the length of exposure. The principal route of exposure is thought to be air inhalation. Sources of increased importance for the general population include food and water. Tumors at multiple and diverse sites have been observed in all species of experimental animals tested for carcinogenicity by inhalation and ingestion of VC. In addition to the health effects of VC, this document also considers the sources, distribution, and control technology. Emissions of VC from VC/PVC plants are estimated to exceed 100 million kilograms annually, about 90 percent of which is from PVC plants. Installation of currently available controls may be adequate to reduce VC emissions from VC/PVC plants in the order of 90 percent. (Katz) W78-03936

STUDIES OF THE ECOLOGICAL IMPACT OF REPETITIVE AERIAL APPLICATIONS OF HERBICIDES ON THE ECOSYSTEM OF TEST AREA C-52A, EGLIN AFB, FLORIDA,

Arment Development and Test Center, Eglin AFB, FL; and Air Force Armament Lab., Eglin AFB, FL.

A. L. Young, C. E. Thalken, and W. E. Ward. Available from the National Technical Information Service, Springfield, VA 22161 as AD-A032 773, Price codes: A07 in paper copy, A01 in microfiche. Report AFATL-TR-75-142, 1975. 142 p, 51 fig, 51 tab, 23 ref.

Descriptors: *Pesticides, *Pesticide kinetics, *Pesticide residues, *Herbicides, *Pesticide toxicity, *2,4-D, *2,4,5-T, *Persistence, *Degradation(Decomposition), *Defoliants, Water pollution sources, Water pollution effects, Path of pollutants, Environmental effects, *Picloram, *Cacodylic acid, *Teratogens.

The report attempts to answer the major questions concerned with the ecological consequences of applying massive quantities of herbicides, (346,117 pounds), via repetitive applications, over a period of eight years, 1962-1970, to an area of approximately one square mile. Moreover, the report documents the persistence, degradation, and/or disappearance of the herbicides from the Test Area's solid and drainage waters and their subsequent effects (direct or indirect) upon the vegetative, faunal and microbial communities. The active ingredients of the four military herbicides were 2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), 4-amino-3,5,6-trichloropicolinic acid (picloram), and dimethylarsinic acid (cacodylic acid). (Katz) W78-03937

THE USE OF ION EXCHANGE METHODS FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS: VII. COPPER, (IN GERMAN), J. Korkisch, L. Goedl, and H. Gross. Talanta. 22(3), p 289-298, 1975.

Descriptors: *Pollutant identification, Analytical techniques, Water analysis, Atomic absorption, *Ion exchange methods, *Trace elements, *Austria, *Copper.

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ON MEDI TISSUES, YELLOW Shimo M. Hama The Jour Fisheries tab, 7 ref

Descripti *Marine f cal techni Biocaccum in tun, 7

The distri lowfin tun skin, and mercury i cant diff found in fish. Merc the other v and vertebral of methyl 1:1. (See a W78-0394

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

A method is described for the separation of ppm levels of Cu from natural waters and final determination by atomic absorption. The sample is made 0.1 M in hydrochloric acid, filtered, treated with ascorbic acid and passed through Dowex 1 X8 (chloride form). The anionic copper(I) chloro-complex is sorbed and the Cu separated from most other elements present. After elution with 1 M nitric acid, the Cu is determined by atomic absorption. The method was used to determine Cu concentrations in the range 10-39 ppm, in some Austrian waters. (See also W77-08787; W76-07409 and W76-07408) --Copyright 1975, Biological Abstracts, Inc. W78-03939

ON MERCURY AND SELENIUM CONTAINED IN TUNA FISH TISSUES - II. TOTAL MERCURY IN MUSCLES AND VISCERA OF YELLOWFIN TUNA (IN JAPANESE), Shimonoeki Univ. of Fisheries (Japan).

M. Takeda, Y. Inamasu, T. Koshikawa, T. Ueda, and M. Nakano.

The Journal of the Shimonoeki University of Fisheries, Vol. 25, No. 1, p 47-65, 1976. 13 ref, 6 tab, 8 ref.

Descriptors: *Fish physiology, *Marine fish, *Metals, *Mercury, *Path of pollutants, Analytical techniques, Laboratory tests, Fish diets, Invertebrates, *Fish food organisms, Distribution, Oceans, Sampling, Lipids, Organic compounds, Public health, Commercial fisheries, *Tuna, Yellowfin Tuna, Thunnus albacares, Bioaccumulation, Tissue analysis.

Total mercury level (T-Hg) and lipid content of 39 yellowfin tunas from the Middle Pacific, West Pacific and East Indian Ocean were determined. The correlations of T-Hg in dark and abdominal muscle to that in dorsal muscle were significant at the 0.01 level and the average T-Hg in these muscles were almost the same (0.21-0.25 microg/g). The T-Hg in muscles, liver, stomach, and intestine contents increased almost exponentially and were significant at the 0.01 and 0.05 levels. The average T-Hg in liver and stomach contents were about 1/2 and the average T-Hg in intestine was about 1/4 of that in dorsal muscle, respectively. The major kinds of food species in the stomach were, in order, as follows: squid, sardine, horse mackerel and shrimp. The correlations of total, polar and nonpolar lipid contents to the T-Hg in dorsal and dark muscles were not significant. (See also W78-03942) (Klein) W78-03941

ON MERCURY AND SELENIUM IN TUNA FISH TISSUES - III. MERCURY DISTRIBUTION IN YELLOWFIN TUNA, (IN JAPANESE), Shimonoeki Univ. of Fisheries (Japan).

M. Hamada, Y. Inamasu, and T. Ueda. The Journal of the Shimonoeki University of Fisheries, Vol. 25, No. 3, p 213-220, 1977. 2 fig, 7 tab, 7 ref.

Descriptors: *Mercury, *Fish physiology, *Marine fish, *Metals, Path of pollutants, Analytical techniques, Laboratory tests, Sampling, Organic compounds, Distribution, Heavy metals, Bioassay, Public health, Commercial fisheries, Bioaccumulation, Tissue analysis, *Tuna, Yellowfin tuna, Thunnus albacares.

The distribution of mercury in the tissues of yellowfin tuna, Thunnus albacares, including muscle, skin, and scales, was investigated. Levels of total mercury in muscle among samples showed significant differences, although no difference was found in the levels of the muscle of a particular fish. Mercury levels in muscle were higher than in the other tissues. In hard tissues such as fins, scale and vertebrae, levels were extremely low. The ratio of methyl mercury to total mercury in muscle was 1:1. (See also W78-03941) (Klein) W78-03942

THE USE OF ION EXCHANGE METHODS FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS: VI. ZINC, (IN GERMAN), J. Korkisch, L. Goedl, and H. Gross. Talanta. 22(3), p 281-288, 1975.

Descriptors: *Pollutant identification, Analytical techniques, *Ion exchange methods, *Trace elements, Atomic absorption, Water analysis, *Austria, *Zinc.

A method is described for the separation of ppm levels of Zn in natural waters and final determination by atomic absorption. The sample is acidified, filtered, treated with potassium thiocyanate, and passed through Dowex 1 X 8 (thiocyanate form). The anionic zinc thiocyanate complex is sorbed and separated from most of the accompanying elements. The column is washed with an aqueous-organic hydrochloric acid solution and with 1 M hydrochloric acid, and the Zn is then eluted with 0.15 M hydrobromic acid and determined directly in the elute by atomic absorption. The method was used for determining Zn in some Austrian waters. Zn contents in the range 18-685 were found. (See also W77-08787; W76-07409 and W76-07408) --Copyright 1975, Biological Abstracts, Inc. W78-03944

AN ENVIRONMENTAL INDEX BASED ON RELATIVE ABUNDANCE OF OLIGOCHAETE SPECIES, California Univ., Santa Barbara.

R. P. Howmiller, and M. A. Scott.

Journal of the Water Pollution Control Federation, Vol. 49, No. 5, p 809-815, 1977. 2 fig, 3 tab, 34 ref.

Descriptors: *Sampling, *Bioassay, *Data collection, *Statistical methods, *Testing procedures, *Oligochaetes, *Eutrophication, *Water pollution, *Distribution patterns, Oligotrophy, Environmental effects, Analytical techniques, Benthic fauna, Mathematical studies, Methodology, *Environmental quality index, Relative abundance.

Several types of indices used in assessing environmental quality, distinguished by the sort of information they summarize, are discussed and illustrated with examples from the literature. Then an index of eutrophication and pollution that was based upon the relative abundance of oligochaete species differing in their response to organic enrichment was described and the results of a trial in which this index was compared to others, which, through commonly used, were deficient in contrast to the oligochaete index. (Katz) W78-03954

THE USE OF ION EXCHANGE METHODS FOR DETERMINING TRACE ELEMENTS IN NATURAL WATERS: V. LEAD, (IN GERMAN), J. Korkisch, and A. Sorio. Talanta. 22(3), p 273-280, 1975.

Descriptors: *Trace elements, *Pollutant identification, *Lead, Atomic absorption method, Ion exchange method, Analytical techniques, *Austria(Danube River), *Spectrophotometry, Water analysis, Potable water.

A method is described which makes possible the separation of Pb from natural waters at the ppm level, and its final determination by spectrophotometry or atomic absorption. The sample is made 0.15 M in hydrobromic acid, filtered, and passed through Dowex 1 X 8 (bromide form). The Pb is sorbed on the resin and most of the other elements present are separated from it. The lead is eluted with 6 M hydrochloric acid and determined by the dithizone method or by atomic absorption. The method was used to determine Pb in drinking water and water from the Danube River. Pb concentration in the range 2-14 ppm were found. (See also W77-08787; W76-07409 and W76-07408) --Copyright 1975, Biological Abstracts, Inc. W78-03955

HORIZONTAL DISTRIBUTION OF PUMPED ZOOPLANKTON DURING A CONTROLLED ECOSYSTEM POLLUTION EXPERIMENT: IMPLICATIONS FOR SAMPLING STRATEGY IN LARGE-VOLUME ENCLOSED WATER COLUMNS, Wood Hole Oceanographic Institution, MA.

For primary bibliographic entry see Field 5B. W78-03958

AN INVESTIGATION OF USING DERIVATION REACTION GAS CHROMATOGRAPHY TO MEASURE ANIONIC WATER QUALITY PARAMETERS, Arkansas Univ. at Little Rock. Dept. of Chemistry.

R. H. Hanson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 471, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Little Rock, Publication No 52, 1977. 28 p, 6 fig, 21 ref. OWRT B-049-ARK(1). 14-34-0001-6004.

Descriptors: *Orthophosphates, *Gas chromatography, *Pollutant identification, Analytical techniques, Measurement, Sampling techniques.

A new analytical method has been developed which provides researchers with another way to measure orthophosphate content in aqueous samples. The reaction gas chromatographic system was capable of analyzing orthophosphate in the range from 0.25-5.0 micrograms of P in 50 microliters of aqueous sample. Flame ionization was the most successful detector. The primary advantage of this technique was the small volume of sample required. W78-03961

COMPUTER TECHNIQUES FOR IDENTIFYING OIL SPILLS, Connecticut Univ., Storrs. Inst. of Water Resources.

Y. T. Chien.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 487, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, October 1977. 19 p, 12 fig, 14 ref. OWRT A-060-CONN(1). 14-31-0001-6007.

Descriptors: *Oil spills, *Computer programs, *Pollutant identification, *Water pollution sources, Mathematical models, Water quality control, Probability, Interactive computer systems, *Pattern recognition(Oil spills), Chemical spectra, Weathering effects.

The use of pattern recognition methods as applied to oil spill identification problems has been investigated. Two computer-based systems that are potentially useful for assisting the human user in the identification process have been developed. The first is an interactive system which is suitable for manipulating discrete waveforms (such as infrared or fluorescent spectra) with the aid of a graphical display. The other system is a general two-dimensional pictorial information processor, potentially useful for identifying oil images such as those produced by thin-layer chromatography. A probability model for matching suspects with spills has also been developed. This model utilizes information contained in chemical spectra obtained from suspects and spill samples. It also considers the possibility that the true spiller escaped without being sampled. W78-03963

SUITABILITY OF FLUOROCARBONS AS TRACERS IN GROUND WATER RESOURCES EVALUATION, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

J. Randall, T. Schultz, and S. Davis.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 488, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, November 1977, 37 p, 16 fig, 4 tab, 40 ref. OWRT A-063-ARIZ(1). 14-34-0001-7006.

Descriptors: *Groundwater, *Tracers, *Gas chromatography, Recharge, Sewage effluents, Organic compounds, Tritium, *Pollutant identification, Texas, Arizona, *Fluorocarbons, Analytical techniques, Air pollution effects.

Trichlorofluoromethane (CCl₃F or F-11) and Dichlorodifluoromethane (CCl₂F₂ or F-12) are artificially produced compounds present in the modern atmosphere. They are slightly soluble in water and can be detected in all surface waters and recently recharged ground water. Because atmospheric concentrations of these compounds have increased rapidly during the past 35 years, equilibrium concentrations in water recharged into the subsurface have also increased. Therefore, F-11 and F-12 concentrations can be used to estimate ground-water age if younger than about 35 years. Furthermore, because F-11 and F-12 have been introduced into the atmosphere at different rates, the ratio of the concentrations of these compounds has changed with time and can also be used to estimate the age of the water. F-11 and F-12 were detected in ground water from Arizona and Texas. A field-operable electron-capture gas chromatograph was constructed for field use, allowing repetitive in situ measurements, thus reducing sample contamination. Results on dating of water were very encouraging. Also, anomalous zones with F-11 and F-12 concentrations greatly exceeding equilibrium values with the atmosphere were found in Arizona and Texas. These areas may be related to landfill leachate, chemical spills, or sewage effluent used for irrigation.

W78-03967

CHRONIC TOXICITY OF METHOXYCHLOR, MALATHION AND CARBOFURAN TO SHEEPSHEAD MINNOWS (CYPRINODON VARIEGATUS),
EG and G Biometrics, Pensacola, FL. Marine Research Lab.

For primary bibliographic entry see Field 5C.

W78-03974

TOXICITY OF DIAZINON TO BROOK TROUT AND FATHEAD MINNOWS,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.

W78-03975

A RAPID ASSESSMENT OF THE TOXICITY OF THREE CHLORINATED CYCLODIENE INSECTICIDE INTERMEDIATES TO FATHEAD MINNOWS,
Environmental Research Lab.-Duluth, MN.
R. L. Spehar, G. D. Veith, D. L. DeFoe, and B. A. Bergstedt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 655, Price codes: A03 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-77-099, August 1977, 30 p, 38 ref, 3 fig, 3 tab.

Descriptors: *Bioassay, Pesticides, *Insecticides, Larvae, Juvenile fish, *Toxicity, *Absorption, *Minnows, Growth rates, Mortality, Juvenile growth stage, Laboratory tests, *Pesticide residues, Aldrin, Chlorinated hydrocarbon pesticides, Pollutant identification, *Hexachlorocyclopentadiene, *Hexachloronorbornadiene, *Heptachloronorbornene, Bioaccumulation, Bioconcentration, Hex.

A rapid assessment study to determine the toxicity and bioaccumulation of three chlorinated cyclohexene insecticide intermediates to fathead

minnow larvae and early juveniles was conducted for 30 days under flow-through conditions. A concentration of 7.3 microg/liter of hexachlorocyclopentadiene caused significant decreases in survival after 4 days. Growth of fish exposed for 30 days was not significantly decreased at any of the concentrations tested. The highest concentration of hexachlorocyclopentadiene having no adverse effect was 3.7 microg/liter. Concentrations of 122 and 226 microg/liter of hexachloronorbornadiene caused significant decreases in survival after 4 days. Growth of 30 day-old larvae was significantly decreased at 38.4 microg/liter and was the most sensitive indicator of toxicity. The highest concentration having no adverse effect was 20.0 microg/liter. The average bioconcentration factor for fish exposed to less than 38.4 microg/liter of this compound was 6400. Survival of fathead minnows exposed to heptachloronorbornene was significantly decreased at 83.5 microg/liter after 4 days. Growth was significantly reduced at 40 microg/liter after 30 days and was the most sensitive indicator of toxicity. The highest concentration having no adverse effect was 25.9 microg/liter. The average bioconcentration factor for fish exposed to less than 40 microg/liter of this compound in water was 11,200. (Katz)
W78-03977

ACCURACY IN TRACE ANALYSIS: SAMPLING, SAMPLE HANDLING, ANALYSIS. VOLUME II.

National Bureau of Standards, Washington, DC. Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 092, Price codes: A99 in paper copy, A01 in microfiche. Proceedings of the 7th Materials Research Symposium, October 7-11, 1974, Gaithersburg, MD. NBS SP-422, Volume II, 1976, 660 p, 197 fig, 147 tab, 703 ref. LaFleur, P.D., Ed.

Descriptors: *Pollutant identification, *Analytical techniques, Water pollution, *Monitoring, *Sampling, Chemistry, *Biology, Bioassay, Gas chromatography, Tracers, Polarographic analysis, Mass spectrometry, Isotope fractionation, Spectroscopy, Neutron activation analysis, Electrochemistry, *Trace elements, *Trace analysis, Electrochemical trace analysis, Anodic stripping voltammetry, Atomic absorption spectrometry.

The focus was on whole chemical analysis, rather than on measurement processes only. Various factors contributing to obtaining accurate analytical results in areas of environmental quality, plant and animal tissue analyses, biological fluids, high purity materials, and geological samples were identified. Papers treated problems of sampling and sample handling as well as analytical methodology, including procedures and problems associated with losses, interferences, contamination, determination, storage, analytical chemistry, gas chromatography, electrochemical trace analysis, pulse polarography, anodic stripping voltammetry, monitoring, mass spectrometry, isotope dilution, atomic absorption spectrometry, trace elements, marine sediments, neutron activation analysis, and electron probe microanalysis. (See W78-03980 thru W78-03987) (Wares-IPA)
W78-03979

SAMPLING PROBLEMS AND THE DETERMINATION OF MERCURY IN SURFACE WATER, SEAWATER, AND AIR,
Reactor Centrum Nederland, Petten.
H. A. Das, and H. A. van der Sloot.
In: Accuracy in Trace Analysis: Sampling, sample Handling, Analysis, Proceedings of the 7th Materials Research Symposium, October 7-11, 1974, Gaithersburg, MD, NBS SP-422, Volume II, p. 669-699, 1976, 13 fig, 8 tab, 15 ref.

Descriptors: *Pollutant identification, *Sampling, *Mercury, Bodies of water, *Surface waters, *Sea water, *Air pollution, Water pollution, Chemical

analysis, Adsorption, Isotherms, Environmental effects, Trace elements, Activation analysis.

A sampling procedure for the determination of mercury (ionic, organically bound, total, and metallic) in surface water and seawater was developed and applied to Dutch surface waters. The design ensured that the concentration of suspended matter was not affected, the separation of the solid fraction from the sample was performed immediately after sampling without losses from the aqueous phase due to adsorption and losses from the solid phase due to desorption at a too low pH, and the aqueous phase was processed immediately to prevent losses due to adsorption on the wall of the container. The total sample volume was (2,500 ml). About 500 ml. were used for the determination of the content of suspended matter and the total amount of mercury in the water. The sample was filtered through a bed of previously purified active charcoal at a low flow rate. About 2000 ml passed a flow-through centrifuge to separate the solid fraction. One liter was used to separate inorganic mercury. The other liter was led through 2 columns of active charcoal to collect all mercury. Procedures were checked with mercury-197 radiotracer as an ion and as incorporated in organic compounds. Mercury was determined by thermal neutron activation, volatilization in a tube furnace, and adsorption on the fresh carbon bed. The rate of desorption from and adsorption on suspended material was measured as a function of the pH of the solution for mercury and various other ions. The separation of mercury from air was obtained by suction through a fine filter and a charcoal bed; determination was then performed as in the case of water samples. (See also W78-03979) (Wares-IPA)
W78-03980

ANALYTICAL CHEMISTRY OF NATURAL WATERS,

Battelle-Pacific Northwest Lab., Richland, WA. D. E. Robertson.

In: Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis, Proceedings of the 7th Materials Research Symposium, October 7-11, 1974, Gaithersburg, MD, NBS SP-422, Volume II, p. 805-836, 1976, 11 fig, 7 tab, 7 ref. AEC AT(45-1)-1830.

Descriptors: *Chemical analysis, Bodies of water, Analytical techniques, Trace elements, Water pollution, *Pollutant identification, Sampling, Storage, Instrumentation, Oceans, Mercury, Geochemistry, Distribution patterns, Errors, Interference.

Using mercury determination as an example, case studies illustrate the parameters which must be evaluated in trace element analysis of natural waters if accurate and precise results are to be obtained. The major sources of error are contamination (positive, negative, or pseudocontamination), chemical interferences, and instrumental disturbances; these sources may pertain to techniques of sampling, containment, handling, analysis, and interpretation. Results of mercury analysis of Atlantic Ocean seawater samples made during participation in the Geochemical Ocean Sections Study (GEOSECS) project are presented. From 22 stations, over 1,000 seawater samples, blanks, and standards were analyzed to provide data to characterize oceanic distribution of mercury in the western basin of the Atlantic Ocean. The analytical method used is based on the cold vapor, ultraviolet absorption detection of vaporized elemental mercury. A parameter evaluation, considering sampling techniques, storage methods, yields of chemical manipulations, procedural blanks, verification, standard references, precision determination, and chemical/instrumental interferences, was carried out to ensure accuracy. A reasonably accurate picture of the actual large scale geographical and vertical distribution of mercury was obtained, with the only uncertainty due to minor sampling and storage problems. (See also W78-03979) (Wares-IPA)
W78-03982

MONITORING WATER ELECTROCHEMICAL
Texas Inst. Lab.
G. K. Rice
In: Accuracy Handling, Research
Gaithersburg, 915, 1976, 2199. ONR

Descriptor
*Monitoring
Electrochemical
pollution,
*ion-select

The application method for seawater described. trates was of a flow at trace monitoring smattering of sea materials water wave In addition, surfaces, that contain complex chemical effect the d Operation aboard a s trical effe seawater minimizin and for chemical ambient b indicate analytical pling pret avoiding (IPA) W78-03980

ELECTRICAL AND CHEMICAL METALS
Institut für M. Branicki
In: Accuracy Handling, Research
Gaithersburg, MD, 1976. 3 fig

Descriptor
*Electroch
*Heavy Lead, Chelation, stripping.

Experi technique to direct metal ion present, and other organic ligands, stripping carbon electrodes of cadmium mercury distribution of zinc behavior in a bottle

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

MONITORING DISSOLVED COPPER IN SEA-WATER BY MEANS OF ION-SELECTIVE ELECTRODES,

Texas Instruments Inc., Dallas, Central Research Lab.

G. K. Rice, and R. J. Jasinski.

In: Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis Proceedings of the 7th Research Symposium, October 7-11, 1974, Gaithersburg, MD, NBS SP-422, Volume II, p 899-915, 1976. 8 fig, 2 tab, 10 ref. ARPA Order No 2199. ONR 0014-72-C-0368.

Descriptors: *Pollutant identification, *Monitoring, *Ion transport, *Copper, Electrodes, Electrochemistry, Sea water, Adsorption, Water pollution, *Trace elements, Chemical properties, *Ion-selective electrode, *Cupric ion, Flow cell.

The application of an ion-selective electrode method for continuously monitoring copper ions in seawater without sample pretreatment is described. The necessary sensitivity of the electrodes was achieved by preconditioning and by use of a flow cell configuration. Response times, even at trace concentrations, were adequate for monitoring small changes in the copper ion concentration of seawater. Evaluating the effects of solid materials on the chemistry of copper ions in seawater was simplified by the speed and convenience of the ion selective electrode technique. In addition to the adsorption of metal ions on solid surfaces, copper ion electrode analysis indicated that contaminants from some solid materials form complexes with copper ion in solution. Changes in chemical properties, such as pH, measurably affect the distribution of copper ions in seawater. Operation of a trace sampling and analysis system aboard a ship is complicated by chemical and electrical effects of the ship's hull on the continuous seawater flow stream. A method was found for minimizing electrical 'noise' in the flow stream and for distinguishing the copper ion potential of chemical contamination due to the ship from the ambient background of natural seawater. Results indicate the practicality of developing trace analytical methods which require little or no sampling pretreatment for true on-site analysis, thus avoiding many of the problems of sampling and sample handling. (See also W78-03979) (Wares-IPA)

W78-03983

ELECTROANALYTICAL DETERMINATION AND CHARACTERIZATION OF SOME HEAVY METALS IN SEA-WATER,

Institut Rudjer Boskovic, Zagreb (Yugoslavia).

Center for Marine Research.

M. Branić, L. Sipos, S. Bubić, and S. Kozar.

In: Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis Proceedings of the 7th Materials Research Symposium, October 7-11, Gaithersburg, MD, NBS SP-422, Volume II, p 917-928, 1976. 3 fig, 4 tab, 28 ref. NBS/IG-191/JF.

Descriptors: *Pollutant identification, *Electrochemistry, *Sea water, *Trace elements, *Heavy metals, Adsorption, Copper, Cadmium, Lead, Chemical analysis, Speciation, Zinc, Stability, Chelation, *Electrochemical analysis, *Anodic stripping voltammetry, Complexation, Hydrolysis.

Experience with application of electroanalytical techniques is presented and discussed with regard to direct determination of concentrations of some metal ions, characterization of the species actually present, and the study of chelation, hydrolysis, and other interactions between metallic ions and organic ligands in natural aquatic systems. Anodic stripping voltammetry (ASV) with rotating glassy carbon electrode has been used for determination of cadmium, lead, and copper; slowly dropping mercury electrode has been used for determination of zinc. The reproducibility of measurements, behavior of electrodes, the role of cell and storage bottle materials, sampling procedures, and

problems of sample storage are discussed. By use of voltammetric measurements with accumulation at various constant potentials representing potential changes in the composition of solution, the distribution of ionic species can be determined at concentration levels as low as the detection limit of the technique. Using this method, the predominant ionic species of cadmium naturally present in seawater were determined as mono and bichloro complexes. ASV is a technique useful not only for analytical purposes, but also for the study of complexation, hydrolysis, and chelation of trace metals at low concentration levels. (See also W78-03979) (Wares-IPA)

METHODOLOGICAL CONSIDERATIONS IN WESTERN LAKE SUPERIOR WATER-SEDIMENT EXCHANGE STUDIES OF SOME TRACE ELEMENTS,

National Water Quality Lab., Duluth, MN.

J. E. Poldoski, and G. E. Glass.

In: Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis Proceedings of the 7th Materials Research Symposium, October 7-11, 1974, Gaithersburg, MD, NBS SP-422, Volume II, p 1073-1088, 1976. 6 fig, 4 tab, 25 ref.

Descriptors: *Pollutant identification, *Lake Superior, *Trace elements, Sedimentation, Electrochemistry, Connate water, Chemical analysis, Filtration, Sampling, *Sediment-water interfaces, Colorimetry, Lake sediments, *Anodic stripping voltammetry, Flameless atomic absorption.

Trace element measurements were taken as a function of geographical area and distance above and below the water-sediment interface in order to detect gradients of certain constituents. Required methodology examination indicated that values obtained from a particular sample type are constrained by uncertainties and operational definitions. Data were taken and experiments conducted at various points in the analytical scheme to determine the influence of sample collection, handling, and analysis steps. Samples were obtained using Van Dorn and Niskin water samplers, an epoxy encapsulated submersible pump, a Shipek dredge, a Phleger gravity corer, and Benthos type gravity corer, with modifications for sediment and bottom water. Samples were treated aerobically or anaerobically, with filtration and analysis carried out as soon as possible after collection to detect any possible absorption or leaching effects by filter and apparatus. Accuracy of results was investigated by analyzing interstitial water samples for copper, manganese, iron, and silica, employing flameless atomic absorption, colorimetric manganese, anodic stripping voltammetry, colorimetric manganese, iron, or colorimetric silica methods. The anaerobic method was preferred since the amount of dissolved element in sediments can change markedly with oxidizing conditions, and since these best approximate actual interstitial water conditions in stratified bodies of water. Flameless atomic absorption was preferred, esp. for copper analysis. Sampling and analytical methods influenced the results of trace analysis sufficiently to warrant the study of their parametric influences in individual studies. (See also W78-03979) (Wares-IPA)

W78-03985

ACCURACY IN DETERMINING TRACE ELEMENT CONCENTRATIONS IN MARINE SEDIMENTS,

Puerto Rico Nuclear Center, Mayaguez.

E. D. Wood, and N. A. Cintron.

In: Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis Proceedings of the 7th Materials Research Symposium, October 7-11, 1974, Gaithersburg, MD, NBS SP-422, Volume II, p 1089-1102, 1976. 6 fig, 3 tab, 5 ref. AEC AT(40-1) 1833.

Descriptors: *Pollutant identification, *Trace elements, *Sea water, *Sediments, *Puerto Rico, Rivers, Standards, Sampling, Calcium, Cadmium, Cobalt, Chromium, Copper, Iron, Magnesium, Nickel, Lead, Strontium, Zinc, Accuracy, Atomic absorption spectrometry, Precision, Replication, Concentration.

An initial survey of a river-ocean system was carried out to determine the distribution and level of trace elements in sediments, including three river discharge regions on the west coast of Puerto Rico. Replicate sediment samples were collected in the course of mapping a portion of the sea floor in the discharge region of the Guanajibo, Mayaguez, and Anasco Rivers. Upon indication of the need for a natural sediment standard, one station in the Guanajibo river discharge region was chosen as a sampling site. Ten replicate grab samples were taken by independent positioning of the ship. The samples were stripped with hydrochloric acid and the resulting solutions analyzed by atomic absorption spectrometry for calcium, cadmium, cobalt, chromium, copper, iron, magnesium, nickel, lead, strontium, and zinc. The standard deviations of replicate analysis of individual samples were generally less than for the individual samples themselves. Chemical standards prepared in the laboratory were used to determine the value of the samples. Particle size and homogeneity were factors considered with respect to the number of replicates required and sample size. The average concentrations for the elements studied are listed in micrograms/gram dry sediment. A composite sample from this location was prepared for use as a standard in future sediment analysis. (See also W78-03979) (Wares-IPA)

W78-03986

ORGANOMERCURY AND TOTAL MERCURY CONTENT OF ENVIRONMENTAL MATRICES AS DETERMINED BY NEUTRON ACTIVATION ANALYSIS,

Pavia Univ. (Italy). Centro di Radiochimica e Analisi per Attivazione.

E. Orvini, and M. Gallorini.

In: Accuracy in Trace Analysis: Sampling, Sample Handling, Analysis Proceedings of the 7th Materials Research Symposium, October 7-11, 1974, Gaithersburg, MD, NBS SP-422, Volume II, p 1233-1240, 1976. 5 tab, 10 ref.

Descriptors: *Pollutant identification, *Mercury, *Environmental gradient, *Separation techniques, Neutron activation analysis, Solvents, Gas chromatography, *Analytical techniques, *Organomercury.

Neutron activation analysis and gas chromatographic techniques are used in the determination of organomercury compounds and of total mercury in environmental matrices. The benzene-cysteine separation procedure of Westoo was coupled to neutron activation analysis so that both the total mercury content and the organomercury fraction could be evaluated in one sample, during one radiochemical separation process. The activity of mercury-197 from the inorganic mercury content of the samples was evaluated with a combustion separation technique carried out on the residual sample after benzene extraction. The activity of mercury-197 from organomercury compounds of the samples was evaluated after extraction and purification with cysteine acetate from benzene fraction. The total mercury content was checked on an untreated portion of the same sample. Results showed that neutron activation analysis, while not used here at its best capability, is reliable and precise, and allows determination of both main species of mercury compounds relevant to environmental studies utilizing only one technique. (See also W78-03979) (Wares-IPA)

W78-03987

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

DANUBIALIA HUNGARICA: LXIII. SEVERAL DATA ON THE ORGANIC MATERIAL CONTENT OF DANUBE WATER, (IN GERMAN), Magyar Tudomanyos Akademia, Budapest. Station for Danube Research.

E. V. Kozma.

Ann Univ Sci Budapest Rolando Eotvos Nominatae Sect Biol. 14, p 47-52, 1972.

Descriptors: Water pollution, Danube River, "Danubialia Hungarica, Hungary, "Organic matter, Oxygen consumption, Seasonal, Measurement, Oxidation.

From July 10, 1968-July 16, 1970, 73 measurements of O₂ consumption using KMnO₄ oxidation in acid medium were made near Alsogod (Hungary). Values from 4.12 mg/l were obtained for O₂ consumption and the living organisms in the filtrate were comprised of seston. The ratio of the oxidizable material dissolved in the water to the particulate oxidizable material was approximately 1:10. O₂ consumption is higher in the summer and lower in the winter. Extreme values of 0.05 and 0.60 mg O₂/l were recorded. (See also W76-12574, W75-08349 and W74-12731)—Copyright 1975, Biological Abstracts, Inc.

W78-03989

MERCURY CONTENT IN SEVERAL SPECIES OF MARINE FISH, Genoa Univ. (Italy). Ist. di Farmacologia e Farmacognosia.

F. Cugurra, and G. Maura.

Bulletin of Environmental Contamination & Toxicology, Vol 15, No 5, May 1976, p 568-573, 3 tab, 26 ref.

Descriptors: *Environmental effects, *Water pollution, Toxicity, *Mercury, Fish, Italy, *Mediterranean Sea, Absorption, Pollutant identification, Bioaccumulation.

Total mercury contents were determined in tinned tuna, anchovies, sardines and mackerel, frozen umbrina and dried cod bought on the market and on fresh fish, sardines and oculata fished in the port of Genoa, Italy. Total mercury contents in tinned tuna varied between species ranging from 0.274 to 1.326 ppm. In other types of tinned fish mercury concentrations ranged from 0.104 ppm in sardines to 0.416 ppm in anchovy. Total mercury contents in fresh fish were higher with concentrations of 2.593 ppm in Oblata melanura and 0.484 ppm in fresh sardines. Frozen Umbrina cirrhosa showed mercury contents of 0.707 ppm and dried Gadus morrhua contained 0.326 ppm mercury. Both fresh and dried dolphin had high mercury concentrations. (Chilton-ORNL)

W78-04041

MERCURY IN CATFISH AND BASS FROM THE SNAKE RIVER IN IDAHO, Idaho State Dept. of Health and Welfare, Boise. Epidemiologic Studies Program.

W. W. Eenson, W. Webb, D. W. Brock, and J.

Gabica.

Bulletin of Environmental Contamination and Toxicology, Vol 15, No 5, May 1976, p 564-567, 2 tab, 6 ref. EPA 68-02-0552.

Descriptors: *Environmental effects, *Water pollution, *Mercury, Fish, Absorption, Bass, *Catfish, Impounded waters, Reservoirs, River flow, Agricultural runoff, Runoff, *Snake River (Idaho).

Bass and catfish were collected from immediately behind a dam, in a free flowing section of river below the dam, and 120 miles upstream from the dam. Analysis showed that there was an increase in mercury concentration from 0.59 ppm to 0.72 ppm in bass between the ages of two and four years in the impounded waters and from 0.67 ppm to 1.15 ppm for the same age period in the free flowing waters. This condition was not apparent,

however, in catfish where both patterns with respect to age and habitat appeared to be reversed. In all cases, however, except for catfish in free flowing waters, the mean levels for mercury concentration set by F. D. A. was exceeded. The Snake River in this area passes through several hundred miles of agricultural land subject to runoff as well as passing through several areas where mercury is found naturally. (Chilton-ORNL)

W78-04047

AUTOMATED METHOD FOR THE DETERMINATION OF TOTAL DISSOLVED MERCURY IN FRESH AND SALINE WATERS BY ULTRAVIOLET DIGESTION AND COLD VAPOR ATOMIC ABSORPTION SPECTROMETRY, Canada Centre for Inland Waters, Burlington (Ontario).

H. Aghemian, and A. S. Y. Chau.

Analytical Chemistry, Vol. 50, No. 1, p 13-16, January, 1978. 3 fig, 16 ref, 2 tab.

Descriptors: *Mercury, *Water analysis, *Pollutant identification, *Spectrophotometry, Ultraviolet radiation, Analytical techniques, Freshwater, Saline water, Water chemistry, Water properties, Water pollution sources, Metals, Trace elements, Organic compounds, *Mercury compounds.

A flow-through UV digester is incorporated into the automated cold vapor atomic absorption spectrometric technique to provide a completely automated method for the determination of total dissolved mercury in fresh and saline natural waters. UV digestion as a means of degradation of organomercurials removes the interference of chloride which is encountered in automated chemical oxidation techniques. The method is shown to degrade seven of the most common organomercurials which may be found in natural waters (phenylmercuric acetate and nitrate, diphenylmercury, and methyl-, ethyl-, methoxyethyl-, and ethoxyethylmercuric chloride). The precision of the method at levels of 0.07, 0.28, and 0.55 micrograms/liter mercury was plus or minus 6.0, plus or minus 3.8, and plus or minus 1.0%, respectively. The detection limit of the system is 0.02 micrograms/liter, and the method is capable of analyzing 30 samples/hr. (Swichtenberg-IPC)

W78-04063

DETERMINATION OF POLYCHLORINATED BIPHENYLS IN PAPER MILL EFFLUENTS AND PROCESS STREAMS, Institute of Paper Chemistry, Appleton, WI.

D. B. Easty, and B. A. Wabers.

Analytical Letters, Vol. 10, No. 11, p 857-867, 1977. 3 fig, 9 ref, 3 tab.

Descriptors: *Polychlorinated biphenyls, *Pollutant identification, *Pulp wastes, *Water analysis, Wastes, Industrial wastes, Water pollution sources, Effluents, Pulp and paper industry, Pollutants, Chlorinated hydrocarbon pesticides, Analytical techniques, Gas chromatography, Chemical analysis, Water pollution, No-carbon paper.

Special techniques were required for isolating PCBs from cellulose fiber-containing effluents and process streams and for determining PCBs in effluents from paper mills recycling no-carbon paper made prior to mid-1971. Significant amounts of PCBs remained on cellulose fibers following sequential funnel extraction of a fiber-water suspension with hexane or 15% methylene chloride in hexane. Reflux of the fibers with 2% alcoholic KOH was necessary to remove the remaining PCBs. PCB losses due to volatilization from aqueous solution occurred during analysis, but these were minimized by working in a cool environment and covering the sample with a layer of hexane. It was hoped that the resolution of gas chromatograms could be sharpened by

perchlorinating PCBs in paper mill effluents to decachlorobiphenyl (DCB), whose long retention time would move it away from interfering peaks. However, alkyl biphenyls and naphthalenes (present in newer no-carbon paper) would also be perchlorinated. These compounds have the same retention time as DCB and would be incorrectly identified as PCBs. Chromium trioxide oxidation was found to be valuable in cleaning up extracts from paper mill effluents. (Swichtenberg-IPC)

W78-04064

HOW TO DESIGN AND SELECT A (WASTE WATER) SAMPLER, Sirco Products Ltd., Vancouver (British Columbia).

C. K. Tompe.

In: International Symposium on Process Control, Canadian Pulp and Paper Association Technical Section, Vancouver, B.C., May 2-4, 1977, Preprint, p 74-77.

Descriptors: *Sampling, *Effluents, *Pulp and paper industry, Pulp wastes, Pollutant identification, Water pollution sources, Equipment, Design, Water sampling, Wastes, Industrial wastes, Water analysis.

Sampling procedures (viz., manual grab, composite, sequential, flow-proportional composite, sequential composite, and continuous composite or sequential sampling), sampling sites, and samplers (chain and bucket, rotating cup, vacuum, and vacuum pressure) are discussed as guides for pulp and paper industries developing an effluent sampling program. (Swichtenberg-IPC)

W78-04068

ARE ALL PULP AND PAPER MILL EFFLUENTS REALLY DIFFERENT. NOT ACCORDING TO THE COD/5-DAY BOD RATIO, Van Luvan Consultants Ltd., Montreal (Quebec). R. van Soest.

Canadian Pulp and Paper Association, Technical Section, 63rd Annual Meeting (Montreal), February, 1977, Preprints, p A5-A15. 10 fig, 11 ref.

Descriptors: *Pulp wastes, *Chemical oxygen demand, *Biochemical oxygen demand, Wastes, Industrial wastes, Water pollution sources, Inorganic compounds, Organic compounds, Lignins, Clays, Toxicity, Pulp and paper industry, Effluents, Aluminum sulfate, Sugars, Kraft mills, Sulfite pulp mills, Waste paper mills, Deinking mills, Groundwood pulp mills.

To determine the relationship between COD and 5-day BOD, influent and effluent values were plotted on a COD vs. BOD graph at the biological treatment plants of several mills (viz., bleached hard-and softwood kraft, bleached/unbleached softwood ammonia- and Na-base sulfite, and bleached stone groundwood pulps and deinked/bleached waste paper furnish). Four regions were defined to include (1) inorganic materials (e.g., cooking chemicals, filler clays, and alum) which exhibit a COD but no BOD since microorganisms cannot degrade them while chemical oxidation is still possible, (2) organic materials (e.g., lignin) which exhibit a COD but no BOD because they are too large and complex to allow biological degradation within the 5-day test period, (3) organic materials (e.g., some sugars and toxic compounds) which exhibit a COD and gradually increasing BOD so that the slope of the curve is gradually decreasing, and (4) organic materials (viz., sugars) which exhibit a constant COD/BOD ratio of ca. 1.6. This is the ratio for 85-90% of the dissolved material found in pulp and paper mill effluents, regardless of what production process generated it, or what biological treatment method removed it. The influence of the remaining dissolved material is of little significance in the design of biological treatment plants. (Swichtenberg-IPC)

W78-04070

ABSORB ACTIVE DURING FROM (ABSO SENTR HIMIC VIZKO G. G. Tselish Khemic

Descripti, *S Analysis pollutant id

A rapid of active tensi ing susp not gre thre absor automa W78-04

AN AN STONE Techni Inst. fu L. Goet In: Produc al Pulp Finland 3 tab.

Descri demand indust paper *Pollut mills, S

The eff of grou sum- loads o tial CO discuss company value for the fil pulp. The solution the spe (ratio to total m comm parable mill eff tial BOD solved industr results COD (DuVal W78-04

SOLID SPENT Cellulo M. Rut Smetal Tappi, 8 re

Descri *Susp Wastes sources Waste Hardw liquors trees(P Beech

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

ABSORPTION METHOD FOR DETERMINING ACTIVATED SLUDGE CONCENTRATIONS DURING PURIFICATION OF EFFLUENTS FROM VISCOSE PRODUCTION (ABSORBTIONNOE OPREDELLENIE KONTSENTRATSIII AKTIVNOGO ILA PRI BIOKHIMICHESKOI OCHISTKE STOCHNYKH VOD VIZKOZNOGO PROIZVODSTVA),
G. G. Golovanov, A. Ya. Rudomir, and V. D. Tselishchev.
Khimicheskie Volokna, No. 2, p 66-67, 1977. 2 ref.

Descriptors: *Activated sludge, *Waste identification, *Spectrophotometry, Analytical techniques, Analysis, Absorption, Waste water treatment, Pollutant identification, *Viscose process.

A rapid method for determining the concentration of activated sludge is based on measuring the intensity of light passing through a solution containing suspended particles. The error of the method is not greater than plus or minus 6%. The sensitivity threshold is 2 mg/liter. The electrical signal of the absorptiometer can be used in conjunction with an automatic control system. (Chern-IPC)

AN ANALYSIS OF BOD AND COD IN THE STONE GROUNDWOOD PROCESS,
Technische Univ. Darmstadt (West Germany).
Inst. fuer Papier-fabrikation.
L. Goettsching, W. Luetgen, and H. L. Dalpke.
In: Proceedings EUCEPA International Mechanical Pulping Conference, June 6-10, 1977, Helsinki, Finland, Volume II, Paper No. 13, 16 p. 3 fig, 6 ref, 3 tab.

Descriptors: *Pulp wastes, *Biochemical oxygen demand, *Chemical oxygen demand, Wastes, Industrial wastes, Water pollution sources, Pulp and paper industry, Effluents, Temperature, *Pollutant identification, *Groundwood pulp mills, Spruce trees(Picea), Mechanical pulping.

The effluent load created during the manufacture of groundwood from spruce is expressed by the sum-type parameters BOD and COD. Pollution loads on the grinder water, as well as specific initial COD and BOD values (per kg of pulp) are discussed. The specific COD of the process is compared with the experimentally determined value for the fibrous material and with the COD of the filtrate from dried commercial mechanical pulp. The process losses occurring through dissolution of wood solids may be gauged by means of the specific initial COD. The ratio of BOD to COD (ratio of biologically degradable material to the total material in the water) averaged 0.37 for the commercial grinder installations, which is comparable with BOD/COD ratio of an average paper-mill effluent. Differences between the specific initial BOD values of commercial amounts of dissolved material in their shower water. When the industrial variations are excluded, the pilot-plant results show a connection between the original COD and the temperature in the grinder pit. (DuVall-IPC)

W78-04089

SOLIDS CONTENT DETERMINATION OF SPENT SULFITE LIQUORS,
Cellulose Attisholz A.G., (Switzerland).
M. Ruitshausen, U. Gasche, P. Felber, L. Smetakova, and T. L. D. Adhiketty.
Tappi, Vol. 60, No. 9, p 155, September, 1977. 1 fig, 8 ref, 2 tab.

Descriptors: *Pulp wastes, *Sulfite liquors, *Suspended solids, *Pollutant identification, Wastes, Industrial wastes, Water pollution sources, Testing procedures, Quality control, Waste identification, Coniferous trees, Softwood, Hardwood, Deciduous trees, *Spent sulfite liquors, Hemlock trees(Tsuga), Spruce trees(Picea), Eucalyptus trees(Eucalyptus), Acacia, Beech trees(Fagus).

A more rapid method has been developed to determine the solids content in calcium- and sodium-base spent sulfite liquors (SSL). In over 2,000 determinations solid concentrations ranged from 10 to 60%. Samples of SSL were from North American eastern and western hemlock, Norway spruce, Portuguese and South African eucalypt, South African acacia, and Swiss beech. The apparatus consists of a Mettler LP 12 drying unit and Mettler P 160 N balance. The procedure involves weighing the SSL on a tared pan, drying it under a 150-watt IR bulb for 45 min, and determining the weight while the lamp is still on, so that moisture cannot interfere with results. The difference in results between the new and standard methods averages about 2%. A comparison of standard deviation shows the new method to be slightly superior. (DuVall-IPC)

W78-04095

GROUNDWATER ANALYSIS BY TRITIUM TECHNIQUE: A PRELIMINARY EVALUATION,

Guam Univ., Agana. Water Resources Research Center.
For primary bibliographic entry see Field 2F.

W78-04100

ACID SNOW-MELT EFFECTS ON WATER QUALITY AND FISH SURVIVAL IN THE ADIRONDACK MOUNTAINS OF NEW YORK STATE,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.

For primary bibliographic entry see Field 5C.

W78-04104

ASSESSMENT OF WATER QUALITY STATUS AND TRENDS IN MINNESOTA BY REMOTE SENSING TECHNIQUES,

Minnesota Univ., Minneapolis.

K. N. Brooks, A. C. Mace, Jr., and M. P. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 822, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, December 1977. 56 p., 6 fig, 10 tab, 44 ref, 3 append. OWRT A-033-MINN(1).

Descriptors: *Water quality, *Remote sensing, *Monitoring, *Minnesota, *Lakes, Reservoirs, Sampling, *Aerial photography, *Minneapolis-St Paul(Minn), Color, Turbidity, Suspended sediments, *Trophic level, Indicators(Water quality), Regression analysis, Chlorophyll, Plankton, Secchi disk depth, Carlson's Trophic State Index, *Pollutant identification.

Monitoring the water quality of lakes and reservoirs by traditional field sampling techniques is a costly and time consuming process. Aerial photography, with limited field sampling, was investigated as a practical alternative to estimate the water quality of ten lakes in the Minneapolis and St. Paul metropolitan area of Minnesota. These ten lakes represented a wide diversity of trophic state and were sampled for color, turbidity, suspended sediment, chlorophyll, phytoplankton numbers, and Secchi disk depth. Regression equations for these water quality indicators were based on film transmittance of black and white panchromatic (2402), color (2448) and color infrared (2443) films as measured with a VP-8 image analyzer. Tests of 1:2000, 1:3000, and 1:6000 scales indicated that 1:3000 should be used. Statistically significant ($\Delta = .05$) prediction equations were developed for Secchi disk depth, turbidity and color. Varying the film processing had little effect on prediction equations, but overexposing the film had an adverse effect. Variability of transmittance readings with time required that a specific set of procedures be followed for practical application. Procedures are outlined which allow film transmittance to be used to estimate Carlson's Trophic State Index. Predicted trophic state indices were not different from those calculated from water quality samples. (Waelti-Minn)

W78-04105

A CRITICAL EVALUATION OF THE NON-RADIOLOGICAL ENVIRONMENTAL TECHNICAL SPECIFICATION - VOL. 1. PROGRAM DESCRIPTION, SUMMARY AND RECOMMENDATIONS,

Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 6G.

W78-04130

A CRITICAL EVALUATION OF THE NON-RADIOLOGICAL ENVIRONMENTAL TECHNICAL SPECIFICATIONS - VOL. 4, SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1,

Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 6G.

W78-04131

ON MERCURY AND SELENIUM CONTAINED IN TUNA FISH TISSUES-IV. METHYL MERCURY LEVEL IN MUSCLES AND LIVER OF YELLOWFIN TUNA, (IN JAPANESE),

Shimonoeki Univ. of Fisheries, (Japan). Dept. of Food Science and Technology.

T. Ueda, and M. Takeda.

Bulletin of the Japanese Society of Scientific Fisheries, Vol. 43, No. 9, p 1115-1121, 1977. 5 ref, 7 fig, 4 tab.

Descriptors: *Mercury, *Commercial fish, *Marine fish, Path of pollutants, Size, Metabolism, Pollutant, Identification, Pacific Ocean, Indi an Ocean, Metals, Heavy metals, Public health *Selenium, *Methyl mercury, Tissue analysis Bioaccumulation, Thunnus albacares, *Yellowfin tuna.

The results of methyl mercury (MeHg) analyses on the muscle tissues and the livers of 39 specimens of yellowfin tuna, *Thunnus albacares*, from the Middle Pacific, the West Pacific, and the East Indian Oceans are presented. The correlations between the levels of MeHg and total mercury (T-Hg) were significant (0.01 level) in both muscle tissues and liver. The difference between the MeHg and the T-Hg levels was insignificant (at 0.01 level) in both dark muscle and liver. On the other hand, the MeHg levels of dorsal muscle were significantly lower than the corresponding T-Hg levels, the difference being approximately 0.04 microgr/gr. The level of MeHg in dark muscle and liver, respectively, correlated significantly with that of dorsal muscle (at 0.01 level). The dark muscle contained a higher level of MeHg than the dorsal muscle, the difference being about 0.03 microgr/gr, while the liver contained less than either (about 0.07 microgr/gr). On the basis of the statistical evaluation described above, the order of mercury levels among the muscles and the liver was estimated as follows: the T-Hg of dorsal muscle is about equal to T-Hg of dark muscle and MeHg of dark muscle. This is greater than MeHg of dorsal muscle which is greater than MeHg of liver and T-Hg of liver. (Katz)

W78-04144

ASBESTOS FIBERS IN NATURAL RUNOFF AND DISCHARGES FROM SOURCES MANUFACTURING ASBESTOS PRODUCTS. PT II-NON-POINT SOURCES & POINT SOURCES MANUFACTURING ASBESTOS PRODUCTS,

McCrone Research Inst., Chicago, IL.

For primary bibliographic entry see Field 5B.

W78-04150

WATER RESEARCH INSTRUMENTATION: 2.
Journal of the Institute of Measurement and Control, Vol. 10, No 10, p 364-365, October, 1977. 1 fig.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

Descriptors: *Flow measurement, *Sewers, *Equipment, *Flowmeters, *Ultronics, Monitoring, Automation, Analytical techniques, Waste water treatment, Instrumentation.

Various measurement techniques which were presented during an open house on May 4-6, 1977, at the Medmenham Laboratory of the Water Research Centre in England are described. A non-contacting flowmeter for use in sewers has been developed by the Water Research Centre in conjunction with the Department of Control Engineering at the University of Bradford. Flow velocity is measured by means of photodetectors which detect turbulent patterns on the fluid surface. An ultrasonic method of flow velocity and suspended solids measurement being developed for use with influent sewage, mixed liquor, returned sludge, and surplus sludge is described. The Digidip, an instrument for measuring levels in sewers, combines the operating principle of an oscillating probe with the reliability of low power digital electronic circuitry. Sulfur hexafluoride has been used as a tracer gas in detecting leaks in sewer lines. Cross-correlation of leak noise by statistical comparison of shape envelope from one microphone with that of another has also been used. (Chilton-ORNL)

W78-04153

MERCURY IN WATERS AND BOTTOM SEDIMENTS OF SOME SELECTED MAZURIAN LAKES,
Akademia Rolniczo-Techniczna, Olsztyn-Kortowo (Poland). Inst. of Agrochemistry. K. Krasnicki, and A. Szczepanski. Polskie Archiwum Hydrobiologii, Vol. 24, No. 3, 1977, p 383-387, 1 fig, 2 tab, 17 ref.

Descriptors: *Pollutant identification, Water quality, Water pollution, *Mercury, Lakes, Sediments, Hypolimnion, *Bottom sediments, Water pollution sources, Fallout, *Lake sediments, *Mazurian lakes (Poland).

Analytical results showed that mercury occurs in the profundal sediments and near-bottom water of all 20 of the lakes investigated. Mercury content in near-bottom water relatively uniform. It was concluded that, at the present time, the investigated area is free from any potential sources of mercury, and that the mercury contents found remain within the natural background range. Almost the whole of mercury occurring in water was organically bound with traces of inorganic mercury being found in only seven lakes. Mercury contents in the bottom sediments was more differentiated. (Chilton-ORNL)

W78-04184

THE DISTRIBUTION OF HEAVY METALS IN ANAEROBIC DIGESTION,
Notre Dame Univ., IN.
T. D. Hayes, and T. L. Theis. Journal Water Pollution Control Federation, January 1978, p 61-72, 15 fig, 5 tab, 21 ref.

Descriptors: *Water pollution, Waste water treatment, Wastes, *Anaerobic digestion, *Heavy metals, Nickel, Copper, Lead, Chromium, Zinc, Cadmium, Distribution, Pollutant identification.

The purpose of this study was to observe the effects of heavy metals on bench-scale anaerobic digesters and to determine the distribution of these metals among various forms in the digester. The disruption of anaerobic digestion by heavy metals characteristically resulted in a lowering of gas production and the proportion of methane present and a subsequent accumulation of intermediate organic acid substrates through inhibition of methanogenic bacteria. This accumulation was less at shock loadings because of rapid toxification of all active bacterial forms in the digester. The order of decreasing toxicity on a weight-weight or molar basis was Ni, Cu, Pb, Cr, Zn. In the dosages

used, Cd produced no toxic or inhibitory effects. Heavy metal removal from digester supernatant was generally greater than 95%. Metals in a precipitated phase could be removed through a mild acidification treatment followed by solids removal but for metals which are organically bound, a prolonged exposure under more extreme acid conditions would be required. (Chilton-ORNL)

W78-04190

WATER QUALITY IN THE FORTH ESTUARY: A DISCRIMINANT FUNCTIONAL ANALYSIS,
Napier Coll. of Commerce and Technology, Edinburgh (Scotland).

P. A. Read, T. Renshaw, A. D. Jackes, P. G. Watson, and K. J. Anderson. Environmental Pollution, Vol 14, 1977, p 275-287, 1 tab, 16 ref.

Descriptors: *Water quality, Analysis, Water analysis, Coasts, Beaches, Chemical analysis, Biochemical oxygen demand, Phosphates, Chlorophyll, *Forth estuary, *Pollutant identification, *Discriminatory functional analysis.

The purpose was to present the results of a discriminant function analysis of water quality measurements recorded on four or more occasions at eight different places, comprising both sandy and rocky shores, on the south coast of the outer Firth of Forth. It was concluded that chemical measures fail to discriminate completely amongst the four sandy beaches because of resuspension, by wave action, of sediments. BOD, PO4 and chlorophyll a appear to be the most effective variables in contributing to the discrimination of sandy beaches. For the four rocky shores, the chemical and microbiological measures included in the analysis completely discriminate within each of the pairs. The more important variables contributing to this discrimination were BOD, PO4, chlorophyll a, number of faecal coliform in the water, and number of faecal coliform in mussels. (Chilton-ORNL)

W78-04199

5B. Sources Of Pollution

THE ACCUMULATION OF 110MAG BY THE PLAICE, PLEURONECTES PLATESSA L. AND THE THORNBACK RAY, RAJA CLAVATA L.
Ministry of Agriculture, Fisheries, and Food, Lowestoft (England). Fisheries Radiobiological Lab.

R. J. Pentreath.

Journal of Experimental Marine Biology and Ecology, Vol. 29, p 315-325, 1977, 15 ref, 7 tab, 3 fig.

Descriptors: *Metals, *Food chains, *Path of pollutants, *Radioisotopes, *Absorption, *Marine fish, *Fish eggs, Larvae, Food webs, Fish physiology, Metabolism, Tracers, Analytical techniques, Radiochemical analysis, *Silver, Raja, *Plaice, Bioaccumulation, Tissue analysis, *Thornback ray.

Studies on the accumulation of 110mAg from both food and water by the plaice, *Pleuronectes platessa* L. and the thornback ray, *Raja clavata* L. have shown that the metabolism of silver by these two species is markedly different. The direct accumulation of the radionuclide from sea water was low for both species, but higher for rays than for plaice. Retention of the radionuclide from labelled *Nereis* by plaice was poor, with a very short biological half-time. In contrast, rays retained the radionuclide well from labelled food with a long biological half-time and with very high concentrations in the liver. Comparisons of 110mAg organ distributions for both species have been compared with stable element determinations. Analyses have also been made of livers from fish caught within the vicinity of nuclear fuel reprocessing plant: 110mAg was found to be present in ray livers but could not be detected in plaice. (Katz)

W78-03702

EFFECT OF SIZE UPON METAL CONTENT OF SHELLFISH,

Imperial Coll. of Science and Technology, London (England). Applied Geochemistry Research Group.

C. R. Boyden.

Journal of the Marine Biology Association of the United Kingdom, Vol. 57, No. 3, p 675-714, 1977, 90 ref, 11 tab, 13 fig.

Descriptors: *Heavy metals, *Absorption, Size, *Mollusks, *Shellfish, *Zinc, *Mussels, *Cadmium, *Path of pollutants, *Oysters, *Copper, *Regression analysis, Estuarine environment, Invertebrates, Commercial shellfish, Public health, Gastropods, Seasonal, Bioaccumulation, *Scallops.

The influence of body size upon whole tissue metal content has been examined for eight elements in a variety of marine and estuarine molluscs. Generally, plotting element content against body weight on a double logarithmic basis produces straight line relationships. The calculated regression slopes for 131 lines fall into two main categories: those around 0.77 and those close to 1.00. In the former cases, e.g. zinc in *Mytilus edulis*, element concentrations are greatest in the smallest individuals; in the second, e.g. cadmium in *M. edulis*, concentrations are independent of size. In a few cases, e.g. cadmium in the limpet *Patella vulgata*, highest concentrations are recorded in the largest individuals. Curves on double logarithmic plots obtained relating copper content to body size in the oysters *Crassostrea gigas* and *O. edulis* and the mussel *M. edulis* introduced to a 'contaminated' environment. Large individuals of these species require longer than 5 months to equilibrate to exceptionally high environmental concentrations of copper. The same is true for zinc in *C. gigas*. In the single case of cadmium in the scallop *Pecten maximus* an upward directed curve was obtained relating cadmium content to body size, resulting in exceptionally high cadmium concentrations in large scallops. Steeper slopes, and almost twice as much variability, was recorded when using wet weight data compared with dry weight. (Katz)

W78-03703

ORGANOCHLORINE AND MERCURY RESIDUES IN CANVASBACK DUCK EGGS, 1972-73,

Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.

R. C. Stendell, E. Cromartie, S. N. Wiemeyer, and J. R. Longcore.

Journal of Wildlife Management, Vol. 41, No. 3, p 453-457, 1977, 3 tab, 23 ref.

Descriptors: *DDT, *DDD, *DDE, *Pesticide residues, *Bird eggs, *Polychlorinated biphenyls, *Mercury, *Path of pollutants, *Canvasback duck, Chlorinated hydrocarbon pesticides, Metals, Dieldrin, Reproduction, Waterfowl, Water birds, Ducks (Wild), Bioaccumulation.

Eggs of canvasback ducks (*Aythya valisineria*) from several major breeding areas were analyzed for organochlorine and mercury residues. Polychlorinated biphenyls (PCBs) were detected in 96 of 97 eggs, in concentrations up to 29 ppm (wet wt.). DDE occurred in 79 percent of the samples with a maximum residue of 12 ppm (wet wt.). DDT, DDD, dieldrin, hexachlorobenzene, cis-chlordane, heptachlor epoxide, and oxychlordane were detected less frequently. Mercury was detected in only 6 of 34 eggs analyzed. Most of the eggs contained concentrations of organochlorines and mercury below levels known to cause adverse effects on avian survival or reproduction. (Katz)

W78-03704

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

MERCURY IN BENTHIC INVERTEBRATES OF THE ELBE ESTUARY.

Hamburg Univ. (West Germany). Inst. fuer Hydrobiologie und Fischereiwissenschaft. G.-P. Zauke.

Helgolander wissenschaftliche Meeresuntersuchungen, Vol. 29, p 358-374, 1977. 35 ref, 4 fig, 9 tab.

Descriptors: *Mercury, *Benthic fauna, *Invertebrates, *Estuarine environment, *Food chains, *Brackish water, *Spatial distribution, *Absorption, Sea water, Path of pollutants, Heavy metals, Industrial wastes, Benthos, Crustaceans, Radix, Littorina, Crangon, *River Elbe(Germany), Gammarids, Nereis, Moulting.

Hg concentrations in benthic invertebrates of the Elbe estuary were analyzed by atomic absorption spectrophotometry and instrumental neutron activation analysis. In general Hg levels in organisms decreased from the limnic region to the marine environment. Highest Hg levels were found in *Asellus aquaticus* and *Radix balthica* taken from the Elbe upstream of Hamburg (0.35 and 0.34 ppm wet weight). The concentrations in gammarid species decreased from 0.20 ppm (limnic region) to 0.02-0.05 ppm (brackish and marine environment). Hg levels in organisms from the brackish region proved to be 0.08-0.16 ppm (Littorina littorea), 0.04-0.09 (Crangon crangon) 0.05-0.10 (Corophium volutator) and 0.04-0.08 ppm wet weight (Nereis diversicolor). Some factors which may influence the heavy metal concentrations in aquatic organisms are discussed, such as: food chain, weight of organisms, and elimination via moulting products in the case of crustaceans. (Katz)

W78-03705

ACCUMULATION AND ELIMINATION OF PENTACHLOROPHENOL BY THE BLUEGILL, LEPOMIS MACROCHIRUS.

University of Southern Mississippi, Hattiesburg. Dept. of Biology.

For primary bibliographic entry see Field 5C.

W78-03709

ENERGETICS OF PACIFIC HERRING (CLUPEA HARENGUS PALLASI) EMBRYOS AND LARVAE EXPOSED TO LOW CONCENTRATIONS OF BENZENE, A MONOAROMATIC COMPONENT OF CRUDE OIL.

National Marine Fisheries Service, Tiburon, CA. Tiburon Lab.

For primary bibliographic entry see Field 5C.

W78-03710

ARSENIC CONTENT AND ITS SEASONAL VARIATION IN SEAWEED, (IN JAPANESE),

Shimonoeki Univ. of Fisheries (Japan).

For primary bibliographic entry see Field 5A.

W78-03712

HEAVY METALS, SELENIUM AND ARSENIC IN NINE SPECIES OF AUSTRALIAN COMMERCIAL FISH,

New South Wales Dept. of Fisheries, Sydney (Australia).

For primary bibliographic entry see Field 5A.

W78-03713

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: FORMALDEHYDE,

Atlantic Research Corp., Alexandria, VA.

J. F. Kitchens, R. E. Casner, G. S. Edwards, W. E. Harward, III, and B. J. Macri.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-256 839, Price codes: A10 in paper copy, A01 in microfiche.

Environmental Protection Agency, Report No EPA 560/2-76-009, August 1976. 204 p, 42 tab, 16 fig, 208 ref.

Descriptors: *Water pollution effects, *Toxicity, *Mortality, *Chemical wastes, *Environmental effects, *Public health, Industrial wastes, Industrial production, Persistence, Mammals, Fish, Invertebrates, Bibliographies, Reviews, *Formaldehyde, Paraformaldehyde, Trioxane, Hexamethylene tetramine, Methanamine, Mutagen, Carcinogens.

This report reviews the potential environmental hazards of formaldehyde resulting from its manufacture, use, production from combustion processes and inadvertent production in the environment. Nascent sources of formaldehyde, such as paraformaldehyde, trioxane and hexamethylenetetramine, are also reviewed. The major source of atmospheric discharge of formaldehyde is combustion processes, specifically from automobile emissions. Formaldehyde is also a product of atmospheric photooxidation of hydrocarbons emitted from automobiles. Photochemical degradation of formaldehyde also occurs in the atmosphere. Formaldehyde is a mutagen in lower animals such as *Drosophila* and bacteria. This property is the basis of its use as a fumigant. Even though formaldehyde is a strong alkylating agent, information to date indicates that it is not mutagenic or carcinogenic in mammals, probably due to the mammalian body's ability to repair this type of nucleic acid damage. Formaldehyde is an allergen. It is also highly toxic in low concentrations causing eye and lung damage and affecting the central nervous system. However, formaldehyde is also a metabolite in biological systems and can be efficiently metabolized to formic acid, carbon dioxide and water, or utilized in the one carbon pool. (Katz)

W78-03714

CHLORDANE AND HEPTACHLOR IN RELATION TO MAN AND THE ENVIRONMENT. A FURTHER PESTICIDE REVIEW 1972-1975,

Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.

H. E. Fairchild.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 339, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency, Report No EPA 540/4-76-005, August 1976. 10 tab, 156 ref.

Descriptors: *Pesticides, *Chlorinated hydrocarbon pesticides, *Heptachlor, *Reviews, *Fish, *Wildlife, *Public health, Water, Soils, Air, Environmental effects, Epidemiology, *Pesticide toxicity, Foods, Pesticide residues, *Chlordane.

This report presents an additional review of both chlordane and heptachlor, which is intended to present selected papers appearing in the literature from 1972-1975. The review indicates new and significant literature in the areas of fish, wildlife, distribution in the environment (air, soil, water), residues in crops and food items, and toxicology and epidemiology. The chemistry information for 1972-1975 was published as a part of a 1975 amendment to the 1972 reviews. This review summarizes rather than interprets scientific data studies in the process of updating the earlier reviews of chlordane and heptachlor. It is not intended to correlate data from different sources of present opinions on contradictory findings. The review covers all uses of the pesticides in the United States and should be applicable to future needs in the Agency. (Katz)

W78-03715

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: ACRYLAMIDES,

Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.

L. N. Davis, P. R. Durkin, P. H. Howard, and J. Saxena.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 704, Price codes: A08 in paper copy, A01 in microfiche.

Environmental Protection Agency, Report No. EPA 560/2-76-008, August 1976. 147 p, 36 tab, 17 fig, 162 ref.

Descriptors: *Reviews, *Environmental effects, *Toxicity, Biochemistry, Physiology, *Water pollution effects, Physical properties, Chemical properties, Mammals, Invertebrates, Microorganisms, *Standards, Bioassay, *Acrylamide, Polyacrylamides, Subacute toxicity, Chronic toxicity, Tetragenicity, Mutagenicity.

This report reviews the potential environmental hazard from the commercial use of acrylamide and its derivatives. For the most part, acrylamides are used in the production of polyacrylamides, which are used as flocculants in sewage and wastewater treatment (about 40%) and as a strengthener in the pulp and paper industry (about 20%). Water leaching of the monomer from the polymer has been demonstrated by effluent monitoring, but the monomer has been demonstrated to be biodegradable. Acrylamide causes peripheral neuropathic effects and is, therefore, of occupational concern. Its other toxicological properties are not well defined. From the available information, acrylamides do not appear to be widespread contaminants but local incidences of contamination may occur. (Katz)

W78-03717

PESTICIDAL ASPECTS OF CHLORDANE IN RELATION TO MAN AND THE ENVIRONMENT,

Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.

O. G. Fitzhugh, and H. E. Fairchild.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 107, Price codes: A06 in paper copy, A01 in microfiche. EPA Report No. EPA 540/4-76-006, August 1976. 108 p, 1 fig, 7 tab, 250 ref.

Descriptors: *Pesticide residues, *Path of pollutants, *Toxicity, *Insecticides, *Chlorinated hydrocarbon pesticides, *Soil contamination effects, *Soil treatment, Public health, Environmental effects, Heptachlor, Food chain, Soil environment, Pesticides absorption, Agricultural chemicals, Fish, Shellfish, Birds, *Chlordane.

This review evaluates scientific data in the area of fish, wildlife, distribution of chlordane in the environment (air, soil, water), residues in crops and food items, and toxicology and epidemiology. This review summarizes rather than interprets scientific data studied during the process of reviewing chlordane. It is not intended that this report correlates data from different sources. All uses of the pesticide in the United States are covered. (Katz)

SETTLER'S CABIN PARK: ENVIRONMENTAL ASSESSMENT OF MINE DRAINAGE POLLUTION,

Ackenheil and Associates Geo Systems, Inc, Pittsburgh, PA.

For primary bibliographic entry see Field 5G.

W78-03723

DREDGING OF CONTAMINATED BED SEDIMENT IN JAPAN,

Ministry of Transport, Kobe (Japan). Bureau of Ports and Harbors.

For primary bibliographic entry see Field 5G.

W78-03736

THE MECHANISM OF MERCURY ACCUMULATION IN FISH,

Tsukuba Univ., Ibaraki (Japan). Dept. of Environmental Epidemiology.

M. R. Fujiki, R. Hirota, and S. Yamaguchi.

In: Management of Bottom Sediments Containing Toxic Substances: Proceeding of the Second U.S.-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 89-95. 3 fig, 2 tab.

Descriptors: *Absorption, *Mercury, *Bottom sediments, Industrial wastes, Marine fish, Public health, *Path of pollutants, *Food chains, *Dissolved solids, Laboratory tests, Metals, Heavy metals, Suspended solids, Water pollution sources, Methodology, Bioaccumulation, *Minamata Bay(Japan), *Methylmercury, Chrysophrys sp., *Red Sea Bream.

The factors contributing to methylmercury accumulation in the Red Sea bream (Chrysophrys major) were investigated by using sea water containing methylmercury, bottom sediment from Minamata Bay (methylmercury: 0.015 mg/kg dry weight, total mercury: 192 mg/kg dry weight), and bait containing methylmercury. The contaminated sea water contained 0.5 microg/liter of methylmercury and fish placed in this water accumulated methylmercury in the body, going from a concentration of 0.012 microg/g (muscle tissue) to 0.033 microg/g (muscle tissue). The fish fed on methylmercury bait (0.133 microg/g) accumulated a little methylmercury; the methylmercury concentration in the fish increased from 0.012 microg/g (muscle tissue) to 0.020 microg/g (muscle tissue). Fish raised in a rearing tank containing bottom sediment from Minamata Bay did not show an effective accumulation of methylmercury; and methylmercury accumulation was almost the same as that of the control group. (See also W78-03735) (Katz) W78-03739

DETERMINATION OF TRACE AMOUNTS OF METHYLMERCURY IN SEA WATER,
Kumamoto Univ., (Japan). Dept. of Industrial Chemistry.
For primary bibliographic entry see Field 5A.
W78-03740

BEHAVIOR OF HEAVY METALS AND PCB'S IN DREDGING AND TREATING OF BOTTOM DEPOSITS,
Public Works Research Inst., Tokyo (Japan).

K. Murakami, and K. Takeishi.
In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 107-126. 7 tab, 13 fig.

Descriptors: *Water quality, *Bottom sediments, *Mercury, *Polychlorinated biphenyls, Water pollution sources, Acidity, Pollutants, Dispersion, Solubility, *Heavy metals, Particle size, *Suspended solids, Environmental engineering, Dredging, Water quality control, Solvents, Distribution, Sediments, Cadmium, Lead, Chromium, Metals, Laboratory tests, Turbidity, Landfills, *Pollutant releases.

Water quality is affected when bottom deposits containing toxic substances such as heavy metals and PCBs are dredged and treated. This problem and the results of laboratory experiments on the solubility of these toxic substances when contained in bottom sediments are discussed. Laboratory tests indicate that deposit constituents vary according to particle size and the kind of deposit with heavy metals and PCBs more concentrated in finer grained sediments. Little mercury or PCBs were released from sediments into the overlying water and most was bound to suspended particles. Concentration of dissolved PCBs in the waste water from dredging operations was low and dissolved mercury concentrations was also low in the normal range, of pH. Mercury transferred from the deposits into the water tended to increase sharply when the solvent was of a high pH. When mercury-containing deposits were solidified with an agent of the cement-line group, the solubility of mercury was greater for solidified deposits than for the original deposits. (See also W78-03735) (Katz)

W78-03741

A STUDY ON THE BEHAVIOR OF MERCURY-CONTAMINATED SEDIMENTS IN MINAMATA BAY,
Japan Bottom Sediments Management Association, Tokyo.

T. Yoshida, and Y. Ikeyakai.
In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 127-143. 18 fig, 1 tab.

Descriptors: *Dredging, *Mercury, *Water quality control, *Suspended solids, *Path of pollutants, *Settling basins, Chemical precipitation, *Bottom sediments, *Flocculation, Water quality, Water pollution sources, Pollutants, Separation techniques, Laboratory tests, Water pollution control, Water treatment, *Minamata Bay(Japan), *Sediment disposal.

Studies were conducted to determine the behavior of mercury compounds in sediments during dredging and disposal for application to dredging operations in Minamata Bay. From the studies it was concluded that the concentration of suspended solids in the final effluent should be maintained below 10 mg/kg in order to control water quality. To achieve this it is necessary to treat the spillwater from a settling pond using a clarification plant. If chemical precipitation is employed to remove suspended solids, the combined use of PAC and polyelectrolyte (such as polyacrylamide) is recommended. In the dredging of the sediments there may be no problem concerning mercury release from dredge spoil particles into the seawater. (See also W78-03735) (Katz) W78-03742

USING SAND FILL TO COVER DREDGE SPOILS CONTAINING MERCURY,
Kitakyushu Municipal Bureau of Port and Harbor, Fukuoka (Japan).

For primary bibliographic entry see Field 5G.
W78-03743

INTERCHANGE OF NUTRIENTS AND METALS BETWEEN SEDIMENTS AND WATER DURING DREDGED MATERIAL DISPOSAL IN COASTAL WATERS,
Corvallis Environmental Research Lab., OR.

D. J. Baumgartner, D. W. Schultz, S. E. Ingle, and D. T. Specht.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October, 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 229-245. 2 ref, 7 fig.

Descriptors: *Dredging, *Metals, *Polychlorinated biphenyls, *Methodology, *Analytical techniques, Environmental effects, *Waste disposal, *Absorption, *Path of pollutants, *Sampling, Standards, Water quality control, Distribution patterns, Marine algae, Benthos, Suspended solids, Cadmium, Lead, Mercury, Phosphorous, Nitrogen compounds, *Elliott Bay(Puget Sound), *Dredge spoils.

Conventional barge dumping of over 100,000 cubic meters of channel sediment was arranged by the Corps of Engineers at a controlled experimental dump site in Elliott Bay, Puget Sound to study the fate and effects of metals, PCBs, and nutrients in the dredged materials. Periodic sampling was conducted before, during, and at intervals after dumping to determine the distribution and uptake of materials as well as other biological effects resulting from the dumping. The objective was to provide guidance to the regulatory agencies regarding the effects of disposal of material containing measurable levels of pollutants in 'open water' disposal sites. Research was also directed towards

improving analytical techniques and handling of samples. Perturbations in some water quality parameters were considerable but short-term during the dumping operation. The concentration of chemical species in the water were below the values recommended as maximum concentrations by the U.S.E.P.A. Partial results of sediment analyses indicate that there has not been substantial chemical alteration of the disposal site environment. (See also W78-03735) (Katz) W78-03748

DREDGING CONDITIONS INFLUENCING THE UPTAKE OF HEAVY METALS BY ORGANISMS,

Army Engineer District, San Francisco, CA.

J. F. Sustar, and T. H. Wakeman.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 246-252.

Descriptors: *Dredging, *Environmental effects, *Absorption, *Path of pollutants, *Dissolved oxygen, *Suspended solids, *Trace elements, *Seasonal, *Salinity, *Nitrogen compounds, *Heavy metals, *Invertebrates, Water properties, Water quality, Water pollution sources, Sediment-water interface, Bottom sediments, Lead, Copper, Zinc, Mercury, Cadmium, Mussels, *San Francisco Bay(Calif), *Dredged spoils.

Studies were conducted by the San Francisco District of the U.S. Army Corps of Engineers during the period 1971 through 1976 to evaluate the impacts associated with dredging and sediment release at open water disposal sites in San Francisco Bay. Although significant changes were observed in dissolved oxygen reductions, suspended solids increases, and trace elements, chlorinated hydrocarbons and nitrogen (nitrate and ammonia) releases, the changes were not found to be synonymous with biological impacts. Uptake and desorption of trace elements by organisms were observed. Contaminant levels in estuarine organisms appear to be controlled by a limited number of factors. Suggested factors are the long-term process of sediment resuspension-recirculation, seasonal fluctuations in salinity and sources of contaminants both introduced by man and formed geologically. (See also W78-03735) (Katz) W78-03749

ECOLOGICAL CONSIDERATIONS IN SITE ASSESSMENT FOR DREDGING AND SPOILING ACTIVITIES,

Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 5C.
W78-03751

RECHARGE AND NITROGEN TRANSPORT MODELS FOR NASSAU AND SUFFOLK COUNTIES, N. Y.,
Cornell Univ., Ithaca, NY. Center for Environmental Research.

K. S. Porter, and C. A. Shoemaker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-276 906, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, January 1978. 55 p, 19 fig, 15 tab, 24 ref. OWRT A-075-NY(1). 14-34-0001-7068.

Descriptors: *Computer models, *Groundwater recharge, *Nitrates, *Regional analysis, *Water balance, *Water pollution sources, Aquifer management, Comprehensive planning, Denitrification, Evapotranspiration, Federal water pollution control act, Fertilizers, Land use, Nitrogen, Septic tanks, Soil moisture, Spatial distribution, Water quality, New York, Path of pollutants, *Nitrogen pollution, Groundwater quality, Non-point source pollution.

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DISCHARGES FOR SEAWARD CLUING ANALYSIS
SIX LABORATORIES
YORK, PA
Geologic Div.
R. J. Aronson
Open-file re...

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W78-03735

LEACHING FROM LONG ISLAND
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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

Groundwater aquifers underlying Long Island are the only source of drinking water for more than 2.5 million people in Nassau and Suffolk Counties in Long Island, New York. Due to residential and agricultural land use, the groundwater is being contaminated by nitrogen. In order to quantify both the amount of recharge water and the nitrogen concentration in the recharge, a simulation model has been developed. The model calculates a mass balance of water and nitrogen on 762 cells, each of which is 1.5 miles square. The calculations which are computed daily or monthly are based upon land use, soil type, temperature, precipitation and sewerage in each grid. Detailed soil moisture data were collected at several sites. Data from the early part of the year were used to calibrate the model. Validation was achieved by comparison with independent data collected in the late part of the year. The average recharge of precipitation for Nassau and Suffolk Counties was estimated by the model to be 1140 million gallons per day or 20.5 inches per year. Lawn fertilizer and septic systems were the major sources of nitrogen in the recharge water.

W78-03756

DISCHARGE AND WATER-QUALITY DATA FOR SELECTED STREAMS AT LOW FLOW INCLUDING SOME BOTTOM-MATERIAL ANALYSES, AND LIMNOLOGICAL STUDY OF SIX LAKES, WESTCHESTER COUNTY, NEW YORK,

Geological Survey, Albany, NY. Water Resources Div.

R. J. Archer, and J. T. Turk.

Open-file report 77-781, 1977. 72 p, 9 fig, 18 tab, 14 ref.

Descriptors: *Water quality, *Streams, *Lakes, *Limnology, *Discharge(Water), Basic data collections, Streamflow, Low-flow frequency, Chemical analysis, Lakes, Bottom sediments, Nutrients, Pesticides, Thermal stratification, Waste assimilative capacity, Surface waters, Travel time, New York, *Westchester County(NY), Biological indicators, Algal growth potential.

Water-quality data collected at sites on 33 Westchester County, N.Y., streams August 4 to 6, 1976 during low flow (80-percent or more duration) indicate that although the chemical characteristics of most streams met State standards for water-supply source waters, none met the coliform standard, and several failed to meet standards for organic nitrogen, pH, and dissolved oxygen. Chemical analyses of bottom materials indicated detectable concentrations of the insecticides chlordane, dieldrin, and DDT at most of the 17 stream sites sampled. Polychlorinated biphenyls(PCB's) were found in more than half the samples, and the lead concentration on one stream was significantly higher than at the other sites. The six lakes studied are similar in bedrock geology, climate, and algal types and numbers. Minor differences in the chemistry of the lakes is attributable to the presence or absence of marble (calcium carbonate) in the gneissic basins, septic loadings of soluble constituents, or runoff containing salt from winter road deicing. The lakes probably receive most of their water by direct runoff and groundwater seepage rather than from major streams. All six lakes can be classed as eutrophic on the basis of algal type and density, dissolved-oxygen distribution, and nitrogen and phosphorus concentrations. (Woodard-USGS)

W78-03758

LEACHATE PLUMES IN GROUND WATER FROM BABYLON AND ISLIP LANDFILLS, LONG ISLAND, NEW YORK,

Geological Survey, Mineola, NY. Water Resources Div.

G. E. Kimmel, and O. C. Braids.

Open-file report 77-583, 1977. 72 p, 21 fig, 17 tab, 34 ref.

Descriptors: *Landfills, *Water pollution sources, *Malenclaves, *Path of pollutants, *Groundwater movement, Leachate, Model studies, Data collections, Sampling, Water wells, Aquifer characteristics, Chemical analysis, Mapping, Travel time, Evaluation, New York, *Suffolk County(NY), *Long Island.

Landfills operated by the towns of Babylon and Islip in southwest and central Suffolk County, N.Y., contain urban refuse, incinerated garbage, and scavenger (cesspool) waste; some industrial refuse is deposited at the Babylon site. The Islip landfill was started in 1933, the Babylon landfill in 1947. The landfills are in contact with and discharge leachate into the highly permeable upper glacial aquifer hydraulic conductivity 190 to 500 ft/d. The aquifer is 74 feet thick at the Babylon landfill and 170 feet thick at the Islip landfill. The leachate-enriched water occupies the entire thickness of the aquifer beneath both landfills, but hydrologic boundaries retard downward migration of the plumes to deeper aquifers. The Babylon plume is 1,900 feet wide at the landfill and narrows to about 700 feet near its terminus 10,000 feet from the landfill. The Islip plume is 1,400 feet wide at the landfill and narrows to 500 feet near its terminus 5,000 feet from the landfill. Hydrochemical maps and sections show the distribution of the major chemical constituents of the plumes. The most highly leachate-enriched ground water obtained was from the Babylon site; it contained 860 mg/liter sodium, 110 mg/liter potassium, 565 mg/liter calcium, 100 mg/liter magnesium, 2,700 mg/liter bicarbonate, and 1,300 mg/liter chloride. Simulation of the movement and dispersion of the Babylon plume with a mathematical dispersion model indicated the coefficient of longitudinal dispersion to be about 60 feet squared per day and the ground-water velocity to be 1 ft/d. However, the velocity determined from the hydraulic gradient and public-supply wells in the area was 4 ft/d, which would cause a plume four times as long as that predicted by the model. (Woodard-USGS)

W78-03759

OCURRENCE AND DISTRIBUTION OF COLOR AND HYDROGEN SULFIDE IN WATER FROM THE PRINCIPAL ARTESIAN AQUIFER IN THE VALDOSTA AREA, GEORGIA,

Geological Survey, Doraville, GA. Water Resources Div.

R. E. Krause.

Open-file report 76-378, June 1976. 11 p, 6 fig, 3 ref.

Descriptors: *Groundwater, *Water quality, *Sulfates, *Sulfides, *Color, Artesian aquifers, Water levels, Groundwater recharge, Georgia, *Valdosta area(Ga).

Hydrogen sulfide and color occur in objectionable amounts in ground water from the principal artesian aquifer in the Valdosta, Ga., area. Generally, water from wells south of Valdosta is high in hydrogen sulfide; water from wells north of the city is high in color. Water with high sulfate is likely to be a problem in wells deeper than about 540 ft. Heavy pumping concentrated in a small area may cause high-sulfate water to migrate vertically upward into shallower wells. (Woodard-USGS)

W78-03762

PHYSICAL, CHEMICAL, AND BIOLOGICAL RELATIONS OF FOUR PONDS IN THE HIDDEN WATER CREEK STRIP-MINE AREA, POWDER RIVER BASIN, WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.

D. J. Wangness.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-273 512, Price codes: A03 in paper copy, A01 in microfiche. Water-Resources Investigations 77-72, July 1977. 48 p, 8 fig, 9 tab, 15 ref.

Descriptors: *Coal mines, *Strip mines, *Ponds, *Biological communities, Aquatic environment, Phytoplankton, Periphyton, Invertebrates, Fish, Chemical properties, Biological properties, Physical properties, Salinity, Trace elements, Hardness(Water), Hydrogen ion concentration, Nutrients, Conductivity, Water temperature, *Wyoming, *Hidden Water Creek(Wyo), Freshwater ponds.

The Hidden Water Creek area in Wyoming was mined from 1944 to 1955 and abandoned. The open pits filled with water and pond-type ecosystems developed. Light was transmitted to greater depths within two control ponds located outside the mine area. The lower light transmittance in the ponds within the mined area probably was due, in part, to the greater number of phytoplankton cells. Also, unconsolidated soil material within the mine area was observed to slough off the pond banks, which could add to the concentration of suspended sediments. Dissolved oxygen concentrations were lower in the ponds within the mined area. Most of the major ions (calcium, magnesium, sulfate, and sodium) were present in greater concentrations in the ponds within the mined area. Higher concentrations of bicarbonate and total hardness were in the water within the mined area. Biological communities were less diverse and chemical concentrations fluctuated more in the mined area than in the ponds outside the mined area. (Woodard-USGS)

W78-03763

DISTRIBUTION AND ABUNDANCE OF BENTHIC ORGANISMS IN THE SACRAMENTO RIVER, CALIFORNIA.

Geological Survey, Menlo Park, CA. Water Resources Div.

For primary bibliographic entry see Field 5A.

W78-03773

Some Aspects of the Persistence and Fate of Acrolein Herbicide in Water, Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.

K. H. Bowmer, and M. L. Higgins.

Archives of Environmental Contamination and Toxicology, Vol. 5, No. 1, p 87-96, 1976. 4 fig, 3 tab, 14 ref.

Descriptors: *Path of pollutants, *Persistence, *Acrolein, Flow rates, *Streamflow, Currents(Water), *Aquatic weed control, Murrumbidgee Irrigation Areas(Australia), Chemcontrol, *Hydrogen ion concentration, *Chemical degradation.

An investigation was made of the influence of water quality, particularly pH, on the rate of degradation and the fate of the reaction product of acrolein, a common herbicide for aquatic weeds in lakes and channels. Acrolein added to water from the supply and drainage systems of the Murrumbidgee Irrigation Areas, Australia and to buffered solutions (pH 5.1-8.6) was incubated at 20.6 plus or minus 2C. In buffered solutions an equilibrium was observed after reaction of about 92% of the initial acrolein. In local waters the reaction continued to completion. In buffered solutions during dissipation of 92% of the acrolein initially present, change in total aldehyde was only about 15%. In contrast, in local waters the reaction product was dissipated rapidly when acrolein concentrations fell below about 2 or 3 ppm. The reaction in supply water fitted the results for buffered solutions at the appropriate pH level within a factor of 1.5, but in drainage water the reaction was 2.7 times faster than predicted, suggesting involvement of a catalyst apart from hydroxyl ions. The reaction product of degradation of acrolein in water was nonvolatile, gave a positive reaction with dinitrophenylhydrazine, and dissipated rapidly when acrolein concentrations fell below 2 or 3 ppm. (Harris-Wisconsin)

W78-03817

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

DEGRADATION OF MALATHION BY SALT-MARSH MICROORGANISMS.
Environmental Research Lab., Gulf Breeze, FL.
A. W. Bourquin.
Applied and Environmental Microbiology, Vol. 32, No. 2, p 356-362, February 1977. 3 fig, 3 tab, 30 ref.

Descriptors: *Chemical degradation, *Aquatic microorganisms, *Insecticides, *Malathion, *Biodegradation, *Microbial degradation, *Salt marshes, Microorganisms, Monocarboxylic acid(MCA), Dicarboxylic acid(DCA), K-desmethyl-malathion(KDM), Path of pollutants, Santa Rosa Island(Florida).

A study was made to isolate from a salt-marsh microbes capable of readily degrading malathion and to identify the major metabolites formed during biodegradation of this chemical. Eleven of 15 bacterial cultures isolated from the salt-marsh environment (on Santa Rosa Island, Florida) after malathion enrichment degraded malathion as a sole carbon source. All 15 isolates degraded malathion within five days when an additional carbon source was added. All the microbial systems were found to have an effective carboxyesterase system that caused rapid breakdown of malathion to the acids with a delayed demethylation reaction to produce desmethyl-malathion. Some microbial systems catalyzed demethylation earlier, resulting in a more rapid release of carbon dioxide from the malathion methoxy group. Both sole-carbon-degrading as well as co-metabolizing bacterial cultures, yielded 10 metabolites which were identified by thin-layer chromatography and infrared spectroscopy as: malathion monocarboxylic acid (MCA), malathion dicarboxylic acid (DCA), K-desmethyl-malathion (KDM), and a number of phosphodithionates. Although these metabolites are degraded rapidly by bacterial action and are present in water in low concentrations, their toxicity persists for some time after the parent compound is no longer detectable. (Harris-Wisconsin) W78-03818

DISSOLVED ORGANIC CARBON IN SOME DARK VENEZUELAN WATERS AND A REVISED EQUATION FOR SPECTROPHOTOMETRIC DETERMINATION OF DISSOLVED ORGANIC CARBON.
Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 5A.
W78-03819

INSECTICIDE AND NUTRIENT TRANSPORT IN WATER, RELATED TO AGRICULTURAL LAND USE OF A STREAM BASIN IN ONTARIO, CANADA.
Department of Agriculture, London (Ontario). Research Inst.
J. R. W. Miles, E. F. Bolton, and C. R. Harris.
Archives of Environmental Contamination and Toxicology, Vol 5, No 1, p 119-128, 1976. 10 fig, 1 tab, 10 ref.

Descriptors: *Path of pollutants, *Insecticides, *DDT, *Dieldrin, *Streamflow, *Land use, *Currents(Water), Flow rates, Big Creek(Ontario), *Canada, Diffusion, Pesticide residues, Nutrients, Nitrogen, Phosphorus.

Big Creek, Norfolk County, Ontario, Canada, was selected for the study of relationship between agricultural land use and the water transport of insecticides and nutrients. While Big Creek headwaters flow through dairy cattle country, its central stream passes through a tobacco growing area, and its lower stream reaches a mixed farming area (corn and vegetables). One site from each area, reflecting the different land use patterns, was chosen for water sampling. Results of the water analysis indicate that the average stream flows for the three sites were in proportion of 5.4:2.9:1.0 which is in agreement with the proportion of three

land areas represented by each site (5.1:2.6:1.0). Dieldrin concentrations in the water at three sites were fairly uniform and the three levels of transport were caused by different flows at the three sites. DDT transport showed a similar pattern, with the exception of two sampling days when the transport from the central area was equal to the transport of DDT by the whole creek as measured at the mouth. Loss of potassium, calcium and magnesium was area-dependent. The largest quantities of all nutrients lost occurred early in the season before the crops were sown. (Harris-Wisconsin) W78-03823

MICHIGAN TRIBUTARY LOADINGS TO THE UPPER GREAT LAKES,

Michigan Dept. of Natural Resources, Lansing.
T. A. Newell, and S. G. Buda.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 183, Price codes: A03 in paper copy, A01 in microfiche. Report No EPA-905/4-75-001, July 1976. 30 p, 1 tab, 2 append. 68-01-1899.

Descriptors: *Water pollution sources, *Michigan, *Tributaries, *Lake Superior, *Lake Huron, *Stream loading, Great Lakes, International Joint Commission, Water quality, Data collections, Runoff, Computer programs, Watersheds(Basins), Minnesota, Wisconsin, Baseline studies, Organic loading, Path of pollutants, EPA STORETS.

Sixteen Lake Superior tributaries and seventeen Lake Huron tributaries in Michigan were sampled monthly between July 1973 and June 1975 to compute constituent loadings for each tributary, as part of a study by the International Joint Commission's Upper Lakes Reference Group (IJC-ULRG). Extra samplings were made during spring high runoffs. Fifty-three microbiological, chemical, radiological, metal and other water quality parameters were monitored during the study. Total tributary loadings for the two lakes are given by parameter. The Final Project Report of the IJC-ULRG Working Group C is appended, which includes a table giving relative municipal, industrial, and tributary inputs of chloride, total nitrogen, total phosphorus, total dissolved solids, and dissolved silica from Michigan in the case of Lake Huron, and from Michigan, Minnesota, and Wisconsin for Lake Superior. Michigan developed a computer program utilizing the federal EPA STORETS system for rendering all data into report-ready copy; a description of this program is included in an appendix. Michigan sampled tributary loadings to Lake Superior were (in kg/day): 101,000 chloride, 11,100 total nitrogen, 565 total phosphorus, 1,220,000 total dissolved solids, and 99,200 silica. For Lake Huron, the loadings were 1,110,000 chloride, 68,000 total nitrogen, 5,750 total phosphorus, 9,800,000 total dissolved solids, and 234,000 dissolved silica. (Lynch-Wisconsin) W78-03825

CHLORIDE AND NITROGEN CONCENTRATIONS ALONG THE WEST SHORE OF LAKE ERIE,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
T. J. Ecker, and R. A. Cole.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 557, Price codes: A07 in paper copy, A01 in microfiche. Institute of Water Research, East Lansing, Technical Report No 32.8, May 1976. 132 p, 15 fig, 14 tab, 43 ref, 14 append. MSU-IWR-TR-76-0032.8. X-290059.

Descriptors: *Lake Erie, *Chlorides, *Nitrogen, *Detroit River(MI), *Maumee River(MI), *Raisin River(MI), Great Lakes, Michigan, Powerplants, Electric powerplants, Watersheds(Basins), Eutrophication, Nutrients, Agricultural runoff, Urban runoff.

Water quality in the western basin of Lake Erie near the Monroe (MI) Power Plant depends primarily on input from tributaries due to dissimilar flushing rates, about two months for the streams compared with about three years for the lake as a whole. Three tributaries were studied. The Detroit River contributes 95% of annual inflow of water to the basin, compared with 2.5% for the Maumee River, and 0.5% for the Raisin River. The study, conducted from 1970-75, assesses the impact of once-through cooling, used at the power plant, on redistribution and alteration of influent waters containing chemical elements associated with eutrophication, such nitrogen. The three tributaries are the major sources of nitrogen to the basin. The Detroit River carries nitrogenous waste from Detroit; the Maumee River drains nitrogen from an intensively farmed watershed and from Toledo; and the proximity of the smaller Raisin River to the power plant gives it a disproportionate effect on local nitrogen distribution. Relative concentrations of the chloride ion provided a means of tracing derivation of waters. It was found that the Monroe Power Plant enhanced mixing of Raisin River with lake water, but otherwise had little effect on nitrogen concentration. Nitrate received from Maumee and Raisin River watersheds during heavy winter and spring runoff was the most important source of nitrogen. (Lynch-Wisconsin) W78-03826

ACTINOMYCETE DISTRIBUTION IN NORTHERN GREEN BAY AND THE GREAT LAKES, TASTE AND ODOR RELATIONSHIPS IN EUTROPHICATION OF NEARSHORE WATERS AND EMBAYMENTS,
Michigan Dept. of Natural Resources, East Lansing.
For primary bibliographic entry see Field 5C.
W78-03827

ATMOSPHERIC INPUT OF PHOSPHORUS TO SOUTHERN LAKE HURON, APRIL-OCTOBER, 1975,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. G. Delumya, and R. L. Petel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 943, Price codes: A04 in paper copy, A01 in microfiche. Report No EPA-600/3-77-038, April 1977. 53 p, 14 fig, 12 tab, 19 ref, append. EPA-600/3-77-038, R803086.

Descriptors: Path of pollutants, *Fallout, *Lake Huron, *Phosphorus, *Air pollution effects, Water pollution, Seasonal, Nutrients, Agriculture, Aerosols, Model studies, Michigan, Canada, Sampling, On-site data collections, Great Lakes, Particulates, Wet deposition, Dry deposition.

Atmospheric phosphorus inputs to southern Lake Huron were determined for April-October 1975 through analysis of total integrated fallout from 11 shore-based sampling stations in Michigan and Canada. Additionally, relative inputs of wet and dry fallout were measured using event rain samples and filtered particulate samples from shore-based and shipboard stations. The available phosphorus input rate was recorded at 6.5 mg/sq cm/day, about one-third of total atmospheric phosphorus input. Of available phosphorus, wet input was measured at 2.2 ng/sq cm/day, and dry input at 1.7 ng/sq cm/day. The discrepancy between total available phosphorus and the sum of wet and dry inputs is apparently due to biological events and other local phenomena which can elevate the phosphorus content of the integrated samples. Both wet and dry phosphorus inputs are highest in spring and fall and can be attributed to agricultural activity. At least 10% of inputs are probably due to fossil fuel combustion. Deposition velocity of phosphorus-containing particles was calculated at 0.6 cm/sec using a simple mixing box model. About 25% of both wet and dry inputs of phosphorus is immediately soluble and 50% is

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

potentially available. As shipboard collection of samples proved expensive and inefficient, a permanently anchored platform equipped with electric power is recommended for future sampling. (Lynch-Wisconsin)
W78-03828

IFYGL TEMPERATURE TRANSECTS: TEMPERATURE DISTRIBUTIONS ACROSS THREE SECTIONS OF LAKE ONTARIO CONTINUOUSLY TRANSVERSED OVER FOUR-DAY INTERVALS IN JULY, AUGUST, AND OCTOBER 1972, Canada Centre for Inland Waters, Burlington (Ontario).

For primary bibliographic entry see Field 2H.
W78-03841

INVESTIGATION OF MINING RELATED POLLUTION REDUCTION ACTIVITIES AND ECONOMIC INCENTIVES IN THE MONONGAHELA RIVER BASIN,

Baker (Michael), Jr., Inc., Beaver, PA.
For primary bibliographic entry see Field 5G.
W78-03844

GROUND-WATER POLLUTION PROBLEMS IN THE SOUTHEASTERN UNITED STATES, Geraghty and Miller, Inc., Port Washington, NY. J. C. Miller, P. S. Hackenberry, and F. A. DeLuca. Available from the National Technical Information Service, Springfield, VA 22161 as PB-268 234, Price codes: A17 in paper copy, A01 in microfiche. Report No. EPA-600/3-77-012, January, 1977. 379 p, 55 fig, 66 tab, 185 ref, 4 append.

Descriptors: *Southeast US, *Water pollution sources, *Groundwater, Water quality, Administrative agencies, Aquifers, Karst, Surface-groundwater relationships, Impoundments, Landfills, Waste disposal, Injection wells, Underground storage, Septic tanks, Mine wastes, Agricultural chemicals, Unconsolidated formations.

Ground water of high natural quality can be developed over the major portion of the southeast U. S. Extensive aquifers in the seven-state region under study (Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi) supply 46 percent of the total water withdrawn in the area. At least 90 percent of the population of Florida and Mississippi are dependent upon ground water for drinking water supplies. Principal sources of man-caused ground water quality problems in order of their severity are: surface impoundments, landfills, subsurface storage of waste and surplus water, leaks and spills, agricultural activity, mining, and septic tanks. Findings of this investigation indicate that the cases of contamination recorded to date represent only a small portion of those that actually exist. Recommendations resulting from this study include promotion of the importance of ground water through public-awareness programs in the region, some restructuring of administrative agencies in charge of water pollution control, and initiation of more comprehensive inventorying and monitoring programs in these states. (Eberle-NWWA)
W78-03856

ENVIRONMENTAL ASSESSMENT OF GEOPRESURED WATERS AND THEIR PROJECTED USES, Dow Chemical U. S. A., Freeport, TX. Texas Div. For primary bibliographic entry see Field 4B.
W78-03857

EVALUATION OF SCINTILLATION PROBE PROFILES FROM 200 AREA CRIB MONITORING WELLS, Atlantic Richfield Hanford Co., Richland, WA. Research Dept. K. R. Fecht, G. V. Last, and K. R. Price.

Available from the National Technical Information Service, Springfield, VA 22161 as ARH-ST-156, Price codes: A11 in paper copy, A01 in microfiche. Publ. No. ARH-ST-156, June, 1977. 3 Vol., 496 p, 332 fig, 30 ref, 2 append.

Descriptors: *Radioactive waste disposal, Groundwater, Water pollution sources, Path of pollutants, Stratigraphy, Monitoring, Observation wells, Washington, *Crib facilities, *Scintillation probes.

Ground disposal of liquid radioactive waste from Atlantic Richfield Hanford company separation plants has been effected in the past via liquid dispersion systems known as cribs. Approximately 300 monitoring wells adjacent to over 100 cribs in the Hanford land reservation were logged with a scintillation probe in 1976; these logs were compared to others taken between 1954 and 1973, and profiles were compiled to measure qualitatively the distribution, redistribution, and decay of radioactive contaminants disposed to the ground beneath crib facilities. Data indicate that most contaminants are retained high above the water table, although some breakthrough of radionuclides to the ground water appears to have occurred at 20 crib facilities. In general, no appreciable downward redistribution of radioactive contaminants appears to have occurred after a crib facility has been removed from service in this area; 1976 data suggest that the contaminants are essentially fixed to the sediments. (Eberle-NWWA)
W78-03860

THE REPORT TO CONGRESS: WASTE DISPOSAL PRACTICES AND THEIR EFFECTS ON GROUND WATER: EXECUTIVE SUMMARY.

Environmental Protection Agency, Washington, DC. Office of Water Supply.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 364, Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA-570/9-77-002, January, 1977. 9 fig, 4 tab, append.

Descriptors: *Groundwater, *Waste disposals, *Water pollution sources, *Water quality control, Water wells, Water supply, Aquifers, Industrial wastes, Impoundments, Lagoons, Landfills, Septic tanks, Cesspools, Municipal wastes, Waste treatment, Sludge, Brines, Mines wastes, Injection wells, Groundwater movement, Sewerage, Legislation, Administrative agencies, Feedlot wastes, Land spreading.

This document summarizes the report, 'Waste Disposal Practices and their Effects on Ground Water.' All material presented in the Executive Summary is duplicated in the full Report so that it will stand alone as a complete document. Waste disposal practices included in this study are those activities which result in the actual collection and disposal of liquid, semi-solid, and solid wastes. The first few sections of the report describe the use and occurrence of the ground water resource along with the mechanisms of contamination. These are followed by a discussion of each of the major waste disposal practices responsible for either localized or regional ground water pollution. The next section deals with the importance of non-waste disposal practices as they affect ground water quality. The final two sections define the present status of Federal legislation that applies to ground water protection and the various regulatory options and strategies available to state and local agencies. (Eberle-NWWA)
W78-03864

PLANKTON OF COASTAL LAGOONS: VI. SEASONAL DISTRIBUTION OF PHYTOPLANKTON IN THE YAVAROS LAGOON, SONORA, MEXICO (1969-1970), (IN SPANISH), Universidad Nacional Autonoma de Mexico City. Inst. de Biologia.

H. Santoyo.
Rev Latinoam Microbiol. 16(1), p 49-58, 1974.

Descriptors: *Temperature, Brackish water, Biomass, *Coastal lagoons, *Diatoms, *Distribution, Lagoons, *Mexico(Sonora), *Phytoplankton, *Salinity, *Seasonal cycles, Sonora, *Yavaros Lagoon(Mex).

Phytoplankton, salinity and temperature were analyzed in a seasonal cycle in the Yavaros Lagoon. Three halobiological areas were observed: Euhaline (30-40 parts per thousand), with marine phytoplankton in the central and southeast areas of the lagoon and picoplanktonic forms in the inside margins; Pleiomesohaline (10-18 parts per thousand) and meiomesohaline (3-10 parts per thousand) areas, with brackish water phytoplankton and predominance of picoplanktonic forms; Polyhaline intergradient area (18-30 parts per thousand) between the 2 anterior zones, with little marine and brackish water phytoplankton. Diatom groups had a 90% dominance over the other phytoplankton groups. Phytoplankton blooms were in spring and again in autumn. The most elevated cell densities were registered in the Moroncarit Inlet. The phytoplankton density varied between 5000 to 1,545,000 cells per liter. During the seasonal cycle, an inverse relation was observed between temperature and phytoplankton abundance. (See also W77-03145)—Copyright, 1974, Biological Abstracts, Inc.
W78-03866

THE STATE OF METAL IONS IN SEAWATER, Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 5A.
W78-03870

SOLUTION CHEMISTRY, SOLUBILITY, AND ADSORPTION EQUILIBRIA OF IRON, COBALT, AND COPPER IN MARINE SYSTEMS, Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 5A.
W78-03871

PERIODIC PHENOMENA AT THE MOUTH OF THE MISSISSIPPI RIVER, Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

W. J. Wiseman, Jr., L. D. Wright, L. J. Rouse, and J. Coleman.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A033 744, Price codes: A02 in paper copy, A01 in microfiche. Technical Report No. 223, Reprinted from: Contributions in Marine Science, Vol 20, p 11-32, 1976. 15 fig, 17 ref. ONR-N00014-69-A-0211-0007.

Descriptors: *Internal waves, *Estuaries, *Water pollution sources, *Mississippi River, Deltas, Remote sensing, Time series analysis, Satellite imagery, Plumes, Periodic phenomena.

Time series of temperature fluctuations, as well as aerial and satellite imagery, indicate the presence of periodic phenomena within the effluent from South Pass, Mississippi River Delta. Time scales on the order of 1 min and 15 min recur in both remotely sensed and in situ data, a fact which suggests that the same phenomenon is being measured. Vertical coherence estimates indicate this to be internal wave motion. Estimates of gross Richardson numbers are near critical; instabilities in the wave field are a possible mechanism for entrainment, but cannot account for all the required entrainment. (Sinha - OFIS)
W78-03872

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

WASTE DISPERSION CHARACTERISTICS AND EFFECTS IN AN OCEANIC ENVIRONMENT,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Engineering Dept.
For primary bibliographic entry see Field 5C.
W78-03874

PRELIMINARY REPORT ON IN SITU MEASUREMENTS OF THE EFFECTS OF SEWAGE DISCHARGE FROM NAVY SHIPS OPERATING WITHIN THE 12-MILE LIMIT,
Naval Ship Research and Development Center Bethesda, MD.
For primary bibliographic entry see Field 5B.
W78-03877

FLOW AND MAIN ELEMENTS OF BALANCE OF BIOGENIC SUBSTANCES AND MAIN IONS IN THE KIEV RESERVOIR, (IN RUSSIAN),
Akademiya Nauk USRS, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5C.
W78-03878

MISSISSIPPI SOUND TEMPORAL AND SPACIAL DISTRIBUTION OF NUTRIENTS,
Gulf Coast Research Lab., Ocean Springs, MS.
C. K. Eleuterius.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-265 942, Price codes: A04 in paper copy, A01 in microfiche. Mississippi-Alabama Sea Grant Consortium Report No. MASGP-76-024, 1976. 66 p., 54 fig, 4 tab, 8 ref, append. SG-04-5-158-54.

Descriptors: *Estuaries, *Baseline studies, *Nutrients, *Resources development, *Environmental effects, Water quality, Water resources, Mississippi, Effluents, Nitrates, Phosphates, Dredging, Construction, Temporal distribution, Spatial distribution, Environmental impact, *Mississippi Sound.

Mississippi Sound, an estuarine system, is the eventual recipient of the accumulative effluents from activities throughout the drainage basin and is further altered by other direct actions such as dredging and construction. In order to assess the effect of present and future development on the water quality of the Sound, it is necessary to ascertain the existing regime of nutrients through determination of descriptive norms and causal relationships. A 'baseline' thus established serves as a reference to which perturbations in the nutrient levels can be compared to evaluate whether the level is a normal variation or an abnormality. The estuarine waters are the principal sources of the major elementary components of estuarine organisms: carbonate, phosphate and nitrate ions. While added amounts of phosphates and nitrates serve to increase the fertility of the estuary, excessive amounts result in algae blooms and accompanying anoxic conditions. Excessive nutrient levels result in degradation of water quality and are therefore used as indicators of pollution. One objective of the Mississippi Sound research effort was to ascertain the temporal and spatial distribution of nutrients. (Sinha-OEIS) W78-03880

REMOTE SENSING OPERATIONS (MULTISPECTRAL SCANNER AND PHOTOGRAPHIC) IN THE NEW YORK BIGHT, SEPTEMBER 22, 1975,
National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center. R. W. Johnson, and J. B. Hall, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as N77-18539, Price codes: A02 in paper copy, A01 in microfiche. National Aeronautics and Space Administration Technical Memorandum No. X-73993, February 1977. 13 p., 4 fig, 3 tab, 1 ref.

Descriptors: *Water pollution sources, *Remote sensing, *Waste disposal, New York, Sewage sludge, Outer Continental Shelf, *Ocean dumping, *New York Bight, Plumes.

Ocean dumping of waste materials is a significant environmental concern in the New York Bight. One of these wastes materials, sewage sludge, was monitored in a joint National Aeronautics and Space Administration/National Oceanic and Atmospheric Administration (NASA/NOAA) experiment conducted in the New York Bight on September 22, 1975. NASA remote sensing over controlled sewage sludge dumping included an 11-band multispectral scanner, five multispectral cameras and one mapping camera on the Johnson Space Center NP-3A aircraft. Concurrent in situ water samples were taken and acoustical measurements were made of the sewage sludge plumes during the experiment by NOAA. Data were obtained for sewage sludge plumes resulting from line (moving barge) and spot (stationary barge) dumps. Multiple aircraft overpasses were made to evaluate temporal effects on the plume signature. (Sinha-OEIS) W78-03881

BEHAVIOR OF MERCURY, CHROMIUM, AND CADMIUM IN AQUATIC SYSTEMS,
Georgia Univ., Athens. Dept. of Zoology. James E. Schindler, and J. J. Alberts.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 559, Price codes: A04 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-023, February 1977. 61 p., 22 fig, 5 tab, 112 ref.

Descriptors: *Metals, *Mercury, *Chromium, *Cadmium, *Transportation, Sorption, Sediments, Freshwater fish, Absorption, *Humic acids, Reduction(Chemical), Oxidation, *Path of pollutants, Organic matter, Laboratory tests, *Mosquito fish, Bioaccumulation.

This report is concerned with determining the fate and possible transformations of mercury, cadmium, and chromium in freshwater sediment-water environments. Mercury and cadmium show a high affinity for natural organic (humic and fulvic) material. Organic material may also cause or catalyze the reduction of ionic mercury to elemental mercury. The rate of release of elemental mercury from lake sediments depends on both the amount and form of the organic material present, the Eh and pH of the environment. Under continuous exposure, elemental mercury is readily accumulated by fish (*Gambusia*) at a rate comparable with ionic mercury. However, uptake is five times greater than ionic mercury under periodic exposure conditions. The excretion rates of elemental mercury approximately equal ionic mercury. (Katz) W78-03923

EFFECTS OF FEEDLOT RUNOFF ON FREE-LIVING AQUATIC CILIATED PROTOZOA,
Illinois Univ. at Urbana-Champaign. Dept. of Veterinary Pathology and Hygiene. K. S. Todd, Jr.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 236, Price codes: A02 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, Research Report No 131, August 1977, 13 p., 5 tab, 1 fig. OWRT A-074-ILL (1).

Descriptors: *Water pollution, Water chemistry, Surface water, *Protozoa, Water sampling, *Ciliated protozoa, *Feed lots runoff, Illinois.

Water samples and free-living and sessile ciliated protozoa were collected at various distances above and below a stream that received runoff from a feedlot. No correlation was found between the species of protozoa recovered, water chemistry, location in the stream, or time of collection. (Katz) W78-03929

HEALTH SIGNIFICANCE OF KLEBSIELLA PNEUMONIAE IN DRINKING WATER EMANATING FROM REDWOOD TANKS,
Oregon State Univ., Corvallis. Water Resources Research Inst.

For primary bibliographic entry see Field 5F.
W78-03933

IDENTIFICATION OF ASBESTOS-MATERIALS IN SUSPENDED SOLIDS,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W78-03934

SCIENTIFIC AND TECHNICAL ASSESSMENT REPORT ON VINYL CHLORIDE AND POLYVINYLCHLORIDE,
Environmental Protection Agency, Research Triangle Park, NC. Office of Research and Development.
For primary bibliographic entry see Field 5A.
W78-03936

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS,
Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.
For primary bibliographic entry see Field 5C.
W78-03938

COPPER SORPTION AND RELEASE BY CYCLOTELLA MENEGHINIANA (BACILLARIOPHYCEAE) AND CHLAMYDOMONAS REINHARDTII (CHLOROPHYCEAE),
Ohio State Univ., Columbus. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W78-03945

EFFECT OF HURRICANE ELOISE ON THE BENTHIC FAUNA OF PANAMA CITY BEACH, FLORIDA, USA,
National Marine Fisheries Service, Panama City, FL. Panama City Lab.
For primary bibliographic entry see Field 2L.
W78-03946

PROLONGED RETENTION OF METHYL MERCURY BY MALLARD DRAKES,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center. L. F. Stickel, W. H. Stickel, M. A. R. McLane, and M. Bruns.
Bulletin of Environmental Contamination and Toxicology, Vol. 18, No. 4, p. 393-400, 1977. 2 fig, 1 tab, 14 ref.

Descriptors: *Mercury, Industrial wastes, *Mallard Duck, Ducks(Wild), Migratory birds, *Seasonal, Life cycles, *Path of pollutants, Waterfowl, Spectrometers, Water pollution effects, Diets, *Methyl mercury, Tissue analysis, Bioaccumulation, Dietary uptake.

Mallard drakes accumulated mercury rapidly from dietary dosage of methylmercury dicyandiamide and eliminated it slowly, retaining approximately one half at the end of 84 days; no measurable loss occurred between the end of the 7th and 56th days, but less resumed concurrently with new feather growth, and continued through the 112th day, the close of the study. (Katz) W78-03950

APPLICATION OF VARIOUS MATHEMATICAL MODELS TO DATA FROM THE UPTAKE OF METHYL MERCURY IN BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),
Oak Ridge National Lab., TN. E. H. Curtis, J. J. Beauchamp, and B. G. Blaylock.

Ecological, fig, 1 tab,

Descripto, *Mercury, temperature, dies, *Ma, Analytical, fish, Lab,

Data from bluegill fr, cury as analyzed, one-comp, exponential, (6) empir, hyperbol, favorable, was super, in a man, procedure, W78-03934

HORIZO, ZOOPLA, ECOSYS, PLICAT, LARGE, WOOD, COLUM, I. P. Will, Marine S, 239-253,

Descript, data coll, *D, cal met, technique, *Oithona, Columbi,

A large, zooplank, three, horizontal, zooplank, copepod, tributary, non-random, patterns, horizontal, was not, the samp, etc.; or conditio, W78-03934

BIOKIN, SELS A, Internat, For prim, W78-03935

SPREAD, WAVE, Connect, Resourc, J. D. Lin, Available, Price co, Comple, ref. OW

Descript, water in, Water p, pollution, waves, a, 'velocity

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

Ecological Modelling, Vol. 3, p. 273-284, 1977. 6 fig, 1 tab, 7 ref.

Descriptors: *Mathematical models, *Absorption, *Mercury, *Heavy metals, *Sunfishes, *Water temperature, *Estimating equations, *Model studies, *Mathematical studies, *Statistical methods, Analytical techniques, Methodology, Freshwater fish, Laboratory tests, *Methyl mercury.

Data from the direct uptake of methyl mercury in bluegill from water at 9°C and 0.2 ppb methyl mercury as a function of time were statistically analyzed by several models: (1) Straight line; (2) one-compartment or single-exponential; (3) slope-exponential; (4) two-compartment or double-exponential; (5) three-compartment or storage; and (6) empirical, having the form of a rectangular hyperbola. Each of the models examined has favorable attributes; however, the empirical model was superior in adapting to data and describing it in a manner by which predictive estimation procedures could be developed. (Katz) W78-03951

HORIZONTAL DISTRIBUTION OF PUMPED ZOOPLANKTON DURING A CONTROLLED ECOSYSTEM POLLUTION EXPERIMENT: IMPLICATIONS FOR SAMPLING STRATEGY IN LARGE-VOLUME ENCLOSED WATER COLUMNS,
Wood Hole Oceanographic Institution, MA.
I. P. Williams, V. R. Gibson, and W. K. Smith.
Marine Science Communications, Vol. 3, No. 3, p 239-253, 1977. 6 tab, 9 ref.

Descriptors: *Zooplankton, *Samplings, *On-site data collections, *Distribution, *Spatial distribution, *Distribution patterns, *Copepods, Statistical methods, Populations, Density, Analytical techniques, Methodology, On-site-investigations, *Oithona, Pseudocalanus, Saanich Inlet (British Columbia).

A large-volume pump system was used to collect zooplankton samples from several locations in three 1300 m³ plastic enclosures (CEEs). The horizontal distribution of three groups of zooplankton (Pseudocalanus, Oithona and copepod nauplii) was analyzed. Although the distribution of the organisms was demonstrated to be non-random, tests failed to show any consistent patterns of abundance. It was concluded that the horizontal distribution of zooplankton in the CEEs was not significantly influenced by the location of the sampling position (side of enclosure vs. center, etc.); or by any external factor, such as weather condition. (Katz) W78-03958

BIOKINETICS OF NEPTUNIUM-237 IN MUSSELS AND SHRIMP,
International Lab. of Marine Radioactivity, Monte Carlo (Monaco), Oceanographic Museum.
For primary bibliographic entry see Field 5C.
W78-03959

SPREADING OF OIL SLICKS IN A WIND-WAVE CHANNEL,
Connecticut Univ., Storrs. Inst. of Water Resources.
J. D. Lin, and G. S. Campbell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 486, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1977. 12 p, 6 fig, 11 ref. OWRT A-059-CONN(2). 14-31-0001-5007.

Descriptors: *Oil spills, Flow measurement, *Oil-water interfaces, *Waves(Water), *Wind velocity, Water pollution sources, *Path of pollutants, Oil pollution, *Oil slick spreading, Wind-generated waves, Mechanically generated waves, Laboratory wind-wave channel, Polyethylene sheets, *Drift velocity, Wave steepness, Shear velocity.

Drift velocities of surface films floating on the water surface under the action of wind-generated waves and mechanically generated waves were investigated in a laboratory wind-wave channel by using polyethylene sheets. In order to simulate the drift of oil slicks in a laboratory channel, the size of the film should be greater than two wavelengths for wind-waves and one wavelength for mechanically generated waves. Film drift velocity over wind-generated waves is a function of wind velocity and wave steepness. However, the ratio of drift velocity to shear velocity of the air boundary layer correlates uniquely with wave steepness and becomes independent of wave steepness for sufficiently large wave steepness. For mechanically generated waves, film drift velocity is substantially greater than the surface particle drift of the Stokes waves. In comparison of the drift velocities in a wave field characterized by wave steepness, the effect of wind on drift velocity of surface films predominates in general over that due to waves. Experiments of oil films under the action of wind-generated waves were also carried out in the wind-wave channel. Drift velocities of oil slicks are initially influenced by the size of oil volume due to the asymmetrical spreading in the direction of winds; however, they approach the values of film drift velocities as the fetch increases downwind. (de Lara-Conn) W78-03962

COMPUTER TECHNIQUES FOR IDENTIFYING OIL SPILLS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 5A.
W78-03963

FEEDLOT RUNOFF AND SEWAGE EFFLUENT AS POTENTIAL WATER POLLUTANTS WITH EMPHASIS ON NITROGEN AND PHOSPHATE LEVELS AND OXYGEN DEPLETION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry; and New Mexico Inst. of Mining and Technology, Socorro. Dept. of Biology.
D. K. Brandvold, and J. A. Brierley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 484, Price codes: A03 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute, Las Cruces, Report No 090, Completion Report, November 1977. 20 p, 18 tab, 9 ref. OWRT A-054-NMEX(1). 14-31-0001-5031.

Descriptors: Water pollution sources, *Sewage effluents, Feed lots, *Nitrogen, *Phosphates, Biochemical oxygen demand, Ammonia, Oxygen depletion, Drainage ditches, Waste water treatment, *Feedlot runoff, New Mexico.

The effects of the input from a small sewage plant and a feedlot on a small drainage ditch were investigated. Primary parameters used in the study were bacterial numbers and type, chemical forms of nitrogen, phosphate and dissolved oxygen. The feedlot contributed both Kjeldahl nitrogen and nitrate to the drain. No phosphate contribution was detected. Oxygen levels were unaffected by the feedlot except after storm runoff. The feedlot runoff after heavy rainfall was very high in nitrate, Kjeldahl nitrogen, phosphate and BOD. During the dry time of the year, significant amounts of ammonia were released. Microbial studies were difficult to assess due to high levels associated with agricultural drains. These drains also interfered with chemical studies because of high background levels of pollutants. (Stockton-New Mex State) W78-03968

ACCURACY IN TRACE ANALYSIS: SAMPLING, SAMPLE HANDLING, ANALYSIS. VOLUME II.
National Bureau of Standards, Washington, DC.
For primary bibliographic entry see Field 5A.

W78-03979

SAMPLING PROBLEMS AND THE DETERMINATION OF MERCURY IN SURFACE WATER, SEAWATER, AND AIR,
Reactor Centrum Nederland, Petten.
For primary bibliographic entry see Field 5A.
W78-03980

METHODOLOGICAL CONSIDERATIONS IN WESTERN LAKE SUPERIOR WATER-SEDIMENT EXCHANGE STUDIES OF SOME TRACE ELEMENTS,
National Water Quality Lab., Duluth, MN.
For primary bibliographic entry see Field 5A.
W78-03985

ACCURACY IN DETERMINING TRACE ELEMENT CONCENTRATIONS IN MARINE SEDIMENTS,
Puerto Rico Nuclear Center, Mayaguez.
For primary bibliographic entry see Field 5A.
W78-03986

ORGANOMERCURY AND TOTAL MERCURY CONTENT OF ENVIRONMENTAL MATRICES AS DETERMINED BY NEUTRON ACTIVATION ANALYSIS,
Pavia Univ. (Italy). Centro di Radiochimica e Analisi per Attivazione.
For primary bibliographic entry see Field 5A.
W78-03987

DERIVATION OF RESIDUAL COEFFICIENTS FOR TYPICAL INDUSTRIES IN NEW ENGLAND,
Center for the Environment and Man, Inc., Hartford, CT.
For primary bibliographic entry see Field 5G.
W78-03988

DANUBIALIA HUNGARICA: LXIII. SEVERAL DATA ON THE ORGANIC MATERIAL CONTENT OF DANUBE WATER, (IN GERMAN),
Magyar Tudomanyos Akademia, Budapest. Station for Danube Research.
For primary bibliographic entry see Field 5A.
W78-03989

METABOLISM AND MODEL OF AN ESTUARINE BAY ECOSYSTEM AFFECTED BY A COASTAL POWER PLANT,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 5C.
W78-04036

FUNGI AS A COMPONENT OF FRESHWATER BIOECOSESSES, (IN RUSSIAN),
Akademiya Nauk URSR, Kiev. Inst. Botaniki.
For primary bibliographic entry see Field 21.
W78-04042

ARE ALL PULP AND PAPER MILL EFFLUENTS REALLY DIFFERENT. NOT ACCORDING TO THE COD/5-DAY BOD RATIO,
Van Luren Consultants Ltd., Montreal (Quebec).
For primary bibliographic entry see Field 5A.
W78-04070

BIODEGRADABILITY OF TOXIC COMPOUNDS IN PULP MILL EFFLUENTS,
B. C. Research Ltd., Vancouver.
J. M. Leach, J. C. Mueller, and C. C. Walden.
Canadian Pulp and Paper Association, Technical Section, 63rd Annual Meeting (Montreal), February, 1977, Preprints, p A135-A140. 5 fig, 16 ref, 4 tab.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

Descriptors: *Bleaching wastes, *Biodegradation, *Activated sludge, *Toxicity, Wastes, Industrial wastes, Water pollution sources, *Pulp wastes, Pulp and paper industry, Effluents, Fermentation, Lignins, Microorganisms, Enzymes, Organic acids, Dehydroabietic acid, Pimaric acid, Pimarol, Monochlorodehydroabietic acid, Trichloroguaiacol, Dichlorodehydroabietic acid, Trichloroguaiacol, Tetrachloroguaiacol, Resin acids.

Laboratory batch fermentation studies were conducted to determine the biodegradability by activated sludge of 7 toxic compounds commonly found in bleached kraft mill effluents, viz., dehydroabietic acid (DHA), pimaric acid, and pimarol — all characteristic of toxicants in softwood debarking and pulping effluents, and mono- and dichlorodehydroabietic (DDHA) acids and tri-(TCG) and tetrachloroguaiacol (TCG) — characteristic of bleach plant effluents. Biodegradation of DHA, pimaric acid, and pimarol took place within 2-3 days, but more time may be needed to remove toxic metabolites of DHA and pimarol. DDHA and TCG were the most resistant to biodegradation. Toxic levels of DDHA may arise if resin acids are not efficiently washed from the brown stock prior to bleaching. TCG is probably derived from the lignin that remains in the brown stock entering the bleach plant, and its concentration increases as the kappa-number of the unbleached pulp increases. TCG was not readily degraded under laboratory conditions until the microorganisms adapted by synthesizing the enzymes necessary to attack the molecule. (Swichtenberg-IPC) W78-04072

THE SELF-PURIFICATION OF UNDERGROUND WATERS, (IN RUSSIAN), Belorussian Sanitary-Hygienic Research Inst., Minsk (USSR). A. G. Kokina, and E. A. Hel'fer. Gig Sanit 10, p 106, 1976.

Descriptors: *Self-purification, Groundwater resources, Ions, Water pollution sources, *Chlorides, Microorganisms, *Nitrates, *Sulfates.

On the basis of archival data for 1953-1959 on the chemical composition of intermorainic waters of Quaternary deposits in the region of the filtration fields of a large city, the behavior of Cl, SO and NO ions in underground waters was analyzed. Data from the literature on the microbial population in borehole samples was also studied. There was an interrelationship between the number of microbes in the water as calculated by direct count and the concentration of SO and NO ions formed as the result of the biochemical oxidation of organic compounds (household sewage).—Copyright 1978, Biological Abstracts, Inc. W78-04076

REFINER PULP MILL EFFLUENT, New Zealand Forest Service, Rotorua. S. R. Corson, and J. A. Lloyd.

In: Proceedings EUCEPA International Mechanical Pulping Conference, June 6-10, 1977, Helsinki, Finland, Volume II, Paper No. 15, 32 p. 7 fig, 8 ref, 9 tab.

Descriptors: *Pulp wastes, Effluents, Wastes, Industrial wastes, Pulp and paper industry, Pine trees, Hydrogen ion concentration, Temperature, Chemical oxygen demand, Dissolved solids, Biochemical oxygen demand, Water reuse, Carbohydrates, Lignins, Color, Suspended solids, Water pollution sources, Mechanical pulp mills, White water (Paper machine), Resin acids, Fatty acids, Pinus ponderosa, Pinus radiata, Pinus contorta.

The mill observed in the reported 3-yr project produced medium-fineeness, unscreened, flash-dried pulp by 2-stage mechanical refining of Pinus ponderosa, Pinus radiata, and Pinus contorta mix-

tures. Mill productive capacity increased from 400 to 700 tons/day during the period. Effluent pH was 6.5 and temperature was 35-55°C. Data are presented on COD and extractive content of water flows from various strategic points in the mill. The COD of the dissolved solids fraction of the effluent was 1,000-2,000 mg/liter. This corresponds to a demand of 45 and 25 kg/ton of pulp at water consumption levels of 30 and 15 cu m/ton, respectively. Total effluent COD was 2,000-3,500 mg/liter. Five-day BOD of the dissolved solids in the effluent was 400-600 mg/liter, and 500-800 mg/liter for the total sample. At the upper and lower levels of water usage, BOD was 20 and 9 kg/ton, respectively. The greater variability of the BOD values is apparent in the BOD/COD relationship presented. Use of old chips decreased the BOD and the dissolved solids content in the effluent, but produced no difference in COD. White water temperature had the dominant effect on the dissolved solids content of the effluent at low white water recycle rates, but not at high recycle rates. Resin acids were more abundant in the dissolved solids fraction of the effluent than were fatty acids, but fatty acids predominated in the suspended solids fraction. Up to 40 mg/liter of resin acids were found in the total effluent. Degraded carbohydrates were responsible for the distinct yellow-brown color of the effluent. No significant quantities of lignin were observed in the white water or the effluent. (DuVall-IPC) W78-04091

ECOLOGICAL LAND UNITS OF BEAR CREEK WATERSHED AND THEIR RELATIONSHIP TO WATER QUALITY.

Oregon State Univ., Corvallis. Water Resources Research Inst. For primary bibliographic entry see Field 4D. W78-04099

RUNOFF POLLUTION FROM MULTIPLE FAMILY HOUSING,

Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.

W. Whipple, Jr., J. V. Hunter, and S. L. Yu. Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 805, Price codes: A02 in paper copy, A01 in microfiche. A Partial Completion Report, 17 p, November 1977, 6 fig, 5 tab, 10 ref. OWRT A-046-NJ(2), 14-34-0001-8032.

Descriptors: Pollution, *Urbanization, *Urban runoff, Storm runoff, *Land use, Heavy metals, Ammonia, Nutrients, Phosphates, Lead, Copper, Biochemical oxygen demand, *Water pollution sources, *Nonpoint pollution sources, *Storm runoff pollution, *Multiple family housing, Areawide water quality planning.

Increasingly, residential development in urbanizing areas is accomplished by large housing projects, composed of clusters of townhouses or garden apartments. It is hypothesized that the runoff from such developments should carry more pollution than that from the same number of housing units on separate plots, because the runoff is conveyed directly to drainage channels rather than being drained across lawns and gardens, which may absorb part of the pollutants. In order to evaluate this effect, storm event data were obtained from a planned unit development near Hightstown, N.J., using samples taken every 10 minutes throughout the storm at two different storm sewers. Results show that BOD and phosphate pollution from runoff were much higher per housing unit than from runoff of single family housing, perhaps twice as high. There is also considerable ammonia. Metals pollution from multiple family housing is comparable to that from single family housing with considerable commercial development. The results are significant for areawide water quality planning in metropolitan areas, where projection of future pollution loadings depends upon the land use. W78-04102

THE EFFECTS OF WOOD DEBRIS AND DRIFT LOGS ON ESTUARINE BEACHES OF NORTHERN PUGET SOUND, Western Washington State Coll., Bellingham. Dept. of Geography and Regional Planning. For primary bibliographic entry see Field 2L. W78-04103

PERMISSIBLE LEVELS OF MIGRATION OF CHEMICALS FROM PLASTICS INTO WATER, (IN RUSSIAN), Vsesoyuznyi Nauchno-Issledovatel'skiy Inst. Gigenii i Toksikologii Pestisividov, Kiev (USSR). For primary bibliographic entry see Field 5G. W78-04126

DEVELOPMENT OF A UNIFIED TRANSPORT APPROACH FOR THE ASSESSMENT OF POWER-PLANT IMPACT,

Oak Ridge National Lab., TN. Enegy Div. A. H. Erslan, E. J. Akin, J. M. Barton, J. L. Bledsoe, and K. E. Cross.

Available from the National Technical Information Service, Springfield, VA 22161 as ORNL/NUREG/TM-89, Price codes: A04 in paper copy, A01 in microfiche. ORNL/NUREG/TM-89, Report March 1977, 46 p 12 fig, 30 ref. W-7405-26.

Descriptors: *Environmental effects, *Powerplants, *Model studies, *Mathematical models, Assessments, Temperature, Radioactivity, Chemistry, Biology, Rivers, Estuaries, Lakes, Coasts.

The purpose of the study was to develop mathematical models for fast-transient, one- and two-dimensional transport of thermal, radiological, chemical, and biological properties in rivers, estuaries, lakes, and coastal regions for assessing the impact of power-plant operations. Progress during the first 18 months (through December 1976) is summarized. Included in the models are submodels for sediment transport, exchange of a soluble isotope with sediment, and zone-matching models to connect near-field problems of reentrainment and recirculation with far-field convective transport. Recent work in the areas of thermal, chemical, or radiological transport is described. (Chilton-ORNL) W78-04129

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE KEWAUNEE NUCLEAR POWER PLANT SITE, Argonne National Lab., IL. For primary bibliographic entry see Field 5C. W78-04132

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - THE QUAD-CITIES NUCLEAR POWER STATION SITE, Argonne National Lab., IL. For primary bibliographic entry see Field 5C. W78-04133

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE ZION NUCLEAR POWER STATION SITE, Argonne National Lab., IL. For primary bibliographic entry see Field 5C. W78-04134

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - PRAIRIE ISLAND NUCLEAR GENERATING PLANT SITE, Argonne National Lab., IL. For primary bibliographic entry see Field 5C. W78-04135

ASBESTOS AND DISEASES FACTURE NON-POISON MANUFACTURERS McCrone R. J. Shim Available Service Price codes Report No. 6, fig. 1

Descriptors: *Water pollution sources, Rivers, Studies, Water quality

A nation-wide nonpoint source levels identified asbestos and asbestos fiber analysis natural sites 12 cities in the manufacturing country vs. New Hampshire, many regions see. Three Connecticut, upper Tri-state, Chautauquea county for the asbestos paper, tiles, and varied from controls levels or as high as usually from man over one constituent (Lynch-W78-041

HYDROPOWER Massachussetts Civil Engineering Tech., Civil Water Resources D. R. F. CONF-7-1 Workshop Cooling and Air Conditioning Asilomar 28-October Papers, p.

Describes, *models, *Cooling

The paper models and distribution over the physical changing of classes completed (surface port different far-field) Steps to criteria, biologics that in th

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution—Group 5B

ASBESTOS FIBERS IN NATURAL RUNOFF AND DISCHARGES FROM SOURCES MANUFACTURING ASBESTOS PRODUCTS, PT II—NON-POINT SOURCES & POINT SOURCES MANUFACTURING ASBESTOS PRODUCTS, McCrone Research Inst., Chicago, IL.

I. M. Stewart, R. E. Puttscher, H. J. Humecki, and R. J. Shimp.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 746, Price codes: A08 in paper copy, A01 in microfiche. Report No. EPA-560/6-76-020, October 1976. 166 p, 6 fig, 1 tab, 29 ref. EPA 68-01-2690.

Descriptors: *Asbestos, *Industrial wastes, *Water pollution sources, *Nonpoint pollution, Effluents, Runoff, Seasonal, Water supply, Baseline studies, Industries, Pollution abatement, Sampling.

A nation-wide survey of the impact of point and nonpoint asbestos sources on waterborne asbestos levels identifies and evaluates seven natural asbestos-bearing sites, and 22 plants manufacturing asbestos products. Water samples were analyzed from five cities with water supplies from natural sites with high asbestos content, and from 12 cities with water supplies contaminated by manufacturing operations. Five major areas of the country were investigated: northern Vermont and New Hampshire; southern Montana; Washington-Oregon region; northern California; and the boundary region of Georgia, the Carolinas, and Tennessee. Three river systems were studied: the upper Connecticut, upper Red Rock and Beaverhead, upper Trinity, Little Tennessee, Hiwassee, and Chatoga-Savannah. The 22 plants sampled account for about 45% of the asbestos tonnage used in the United States, and include all major asbestos products— asbestos cement pipe, cement sheet, paper and millboard, roofing and tile, textiles, and friction materials. Effluent treatment varied from none through various settling and pH controls to total recycling. Waterborne asbestos levels originating from natural sources were as high as 100 million fibers/l, and fibers were usually less than 5 micrometers long. Asbestos from manufacturing ranged from undetectable to over one trillion fibers/l. Asbestos paper plants constitute the most serious environmental hazard. (Lynch-Wisconsin)
W78-04150

HYDROTHERMAL MODELING,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering; and Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydraulics.

D. R. F. Harleman.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975. Vol 2. Technical and Topical Papers. p 128-135, 17 ref.

Descriptors: *Environmental effects, *Model studies, *Hydrothermal studies, Mathematical models, Design, Temperature, Discharge(Water), Cooling water, *Thermal pollution, Zone models.

The paper traces the development of hydrothermal models for the prediction of water temperature distributions associated with waste heat emissions over the past decade. Both mathematical and physical models have evolved in response to the changing requirements for the licensing and operation of electric generating stations. This report classes mathematical models as zone models or complete models and discusses three zone models (surface discharge: near-field; submerged, multiport diffuser; near-field; and surface discharge: far-field) which have been developed at MIT. Steps to develop a biologically based temperature criteria, relating hydrothermal models to predicted biological impact, are reviewed. It is suggested that in the future discharge designs will be increas-

ingly determined by site specific biological requirements rather than by arbitrary temperature standards. (See also W78-04155) (Chilton-ORNL)
W78-04164

RADIOMUCIDES IN AQUATIC ECOSYSTEMS ASSOCIATED WITH POWER PLANTS,

Northeast Utilities Service Co., Hartford, CT. Environmental Program Branch.

W. C. Renfro.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975. Vol 2. Technical and Topical Papers. p 170-176, 2 tab.

Descriptors: *Environmental effects, *Water pollution, *Radioisotopes, *Radioactivity, Powerplants, *Nuclear powerplants, Standards, Water quality, Water quality standards, Cooling water, Discharge(Water).

Concentration of radionuclides in primary coolant water of a typical boiling water reactor and liquid radionuclide annual releases from U.S. nuclear power reactors are presented in tabular form. Releases of radionuclides from operating nuclear power plants have amounted to only small fractions of the limits established by Title 10, Code of Federal Regulations, Part 20 (10CFR20). However recent guidelines (10CFR50, Appendix J) will further limit the quantities of radioactive effluents from power reactors. From the standpoint of the electric utilities operating nuclear power reactors, issues in need of research are radioanalytical sensitivity and accuracy of commercial service companies, evaluation of the concept of long-term build-up of radionuclides in aquatic ecosystems around nuclear power plants, and adequacy of concentration factors used for pathway and dose commitment analyses. (See also W78-04155) (Chilton-ORNL)
W78-04167

PROBLEMS ASSOCIATED WITH AQUATIC MONITORING AND RESEARCH AT OPERATING POWER STATIONS,

Consumers Power Co., Jackson, MI. Environmental Planning.

J. Z. Reynolds.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975. Vol 2. Technical and Topical Papers. p 177-181.

Descriptors: *Environmental effects, *Monitoring, Powerplants, *Nuclear powerplants, Aquatic environments, Design, Data collections.

Problems involved in fitting aquatic study programs to actual field situations are reviewed. Four general categories into which these problems fall are identified as: peculiarities of plant design which have failed to make accommodations for representative sampling at critical locations; program logistics which have not anticipated time, manpower and obstacles in collecting, preparing and analyzing samples in the field; program design which has not adequately anticipated natural environmental variability and extremes; and data, after collection and analysis, which does not provide for proper interpretation of impacts being studied. Examples of aquatic studies programs (thermal plume dimensions, entrainment effects, and thermal effects) which do not result in data related to impact evaluation are discussed. It is suggested that research plans which are directed at better utilization of field data for interpreting impacts of practical concern should be of high priority. (See also W78-04155) (Chilton-ORNL)
W78-04168

WHAT CAN WE LEARN FROM THERMAL PLUME PREDICTION,

Corvallis Environmental Research Lab., OR.

M. A. Shirazi.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975. Vol 2. Technical and Topical Papers. p 187-197, 6 fig.

Descriptors: Environmental effects, *Model studies, Mathematical models, Powerplants, Cooling water, *Forecasting, *Thermal plume prediction.

The paper presents background information on thermal plume analysis and prediction. The essential features of the mathematical analysis for jets and plumes is explained and examples are given to demonstrate the strength of these analyses to simulate some important physical processes of a real-world problem and their versatility for producing qualitative predictions in a general situation. (See also W78-04155) (Chilton-ORNL)
W78-04170

RELEASE OF MERCURY AND ORGANICS FROM RESUSPENDED NEAR-SHORE SEDIMENTS,

Florida State Univ., Tallahassee.

For primary bibliographic entry see Field 5C.
W78-04192

SEDIMENT CONTAMINATION AND BENTHIC MACROINVERTEBRATE DISTRIBUTION IN A METAL-IMPACTED LAKE,

Purdue Univ., Lafayette, Ind. Dept. of Bionucleonics.

For primary bibliographic entry see Field 5C.
W78-04193

OCCURRENCE OF METHYL MERCURY IN PIKE AND BALTIC HERRING FROM THE TURKU ARCHIPELAGO,

Turku Univ. (Finland). Inst. of Biochemistry.

For primary bibliographic entry see Field 5C.
W78-04194

THE EFFECT OF ROAD DEICING SALT ON THE DRIFT OF STREAM BENTHOS,

Waterloo Univ. (Ontario). Dept. of Biology.

R. A. Crowther, and H. B. N. Hynes.
Environmental Pollution, Vol. 14, 1977, p 113-126, 5 fig, 42 ref.

Descriptors: Environmental effects, *Water pollution, *Deicers, *Salts, *Benthos, Streams, Drifting(Aquatic), Sodium, Chlorine, Calcium.

An urban stream was monitored for chlorine, sodium, and calcium ions. Winter peaks of concentration were found to be generally associated with periods of low discharge, although there was little direct correlation between salt levels and discharge. In summer, when water levels fall due to evaporation, high temperatures and low rainfall, the correlation was stronger and fairly high levels of salt were found. Laboratory and field experiments indicated that *Gammarus* and *Hydropsychidae* are apparently unaffected by chloride pulses up to 800 mg/l. In one field experiment, a pulse of 2165 mg/l Cl increased the death of all organisms in a salted channel. (Chilton-ORNL)
W78-04196

THE OCCURRENCE OF SOME HEAVY METALS IN POPULATIONS OF THE FRESH-WATER MUSSEL *ANODONTA ANATINA* (L.) FROM THE RIVER THAMES,

Kingston Polytechnic, Kingston upon Thames (England). School of Chemical and Physical Sciences.

R. Manly, and W. O. George.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources Of Pollution

Environmental Pollution, Vol 14, 1977, p 139-154. 3 fig, 4 tab, 31 ref.

Descriptors: Environmental effects, *Water pollution, *Sewage, Sewage effluents, *Heavy metals, *Mussels, Zinc, Lead, Cadmium, Copper, Mercury, *River Thames(England).

Mussels from three urban and four rural sites along the River Thames were analyzed to determine Zn, Ni, Pb, Cd, Cu and Hg levels. The daily flow of sewage effluent was at least 13 times greater in the vicinity of the urban sites than in that of the rural sites. Higher concentrations of Zn, Ni, Pb, and Cd were found in mussels from the urban sites. With the exception of nickel, considerable variations were found in the concentrations of all metals in mussels from the same locality which were apparently related to dry body weight in some or all of the samples comprised of more highly contaminated individuals. The metals were not evenly distributed throughout the tissues of mussels with each element having a somewhat different distribution from the others. (Chilton-ORNL)
W78-04198

CONTROL OF NONPOINT WATER POLLUTION FROM AGRICULTURE: SOME CONCEPTS,
Agricultural Research Service, Chickasha, OK. Southern Great Plains Watershed Research Center.
For primary bibliographic entry see Field 5G.
W78-04200

5C. Effects Of Pollution

THE EFFECT OF SULFIDE ON THE BLUE-GREEN ALGAE OF HOT SPRINGS II. YELLOWSTONE NATIONAL PARK,
Oregon Univ., Eugene. Dept. of Biology.
R. W. Castenholz.
Microbial Ecology, Vol 3, No 2, 1977, p 79-105. 10 fig, 4 tab, 38 ref. NSF GB-31945x, BMS72-01806 A03.

Descriptors: *Algae, *Hot springs, *Sulfides, Water temperature, Photosynthesis, Aquatic plants, *Inhibitors, Toxicity, *Cyanophyta, *Yellowstone National Park(WY), Mammoth Hot Springs(WY), DCMU.

While most blue-green algae are intolerant of even low concentrations of soluble sulfide in neutral and alkaline pH waters of hot springs, exceptions include *Oscillatoria amphigranulata* in New Zealand, and as shown in the present study, *Spirulina* *labyrinthiformis* in the near-neutral hot springs of the Mammoth area in Yellowstone National Park (WY). Source waters of the Upper Terraces of Mammoth generally have pH values of 6.2-6.8, and a mean sulfide concentration of 1.8 mg/l (H2S, HS(-), and S(2-)). Maximum concentration was 4.2 mg/l. Field observations showed domination of substrate covers by *Spirulina* *labyrinthiformis* below 50C. Laboratory experiments indicated that sulfide-adapted *Spirulina* photosynthesized at maximum rates at 45C (with a range of 42-48C), and at about 300-700 micro-Ein/sq m/sec of visible radiation. At sulfide concentrations no higher than about 1 mM *Spirulina* actually showed a slight increase in photosynthesis. However, *Spirulina* not adapted to sulfide in nature was severely inhibited by it. Nonadapted *Spirulina* continuously exposed to over 30 micro-M tolerated at least 1 mM without inhibition. In sulfide-adapted *Spirulina*, inhibition of photoincorporation by DCMU, hydroxylamine, or far red light was relieved by addition of sulfide. It appears that sulfide is used as a photoreductant of CO2, and in some blue-green algae photosystem II is poisoned by a low sulfide concentration, thus making them sulfide-dependent if they are to continue photosynthesizing in a sulfide environment. (See also W77-03045) (Lynch-Wisconsin)

W78-03701

THE ACCUMULATION OF 110MAG BY THE PLAICE, PLEURONECTES PLATESSA L. AND THE THORNBACK RAY, RAJA CLAVATA L.,
Ministry of Agriculture, Fisheries, and Food, Lowestoft (England). Fisheries Radiobiological Lab.
For primary bibliographic entry see Field 5B.
W78-03702

EFFECT OF SIZE UPON METAL CONTENT OF SHELLFISH,
Imperial Coll. of Science and Technology, London (England). Applied Geochemistry Research Group.
For primary bibliographic entry see Field 5B.
W78-03703

ORGANOCHLORINE AND MERCURY RESIDUES IN CANVASBACK DUCK EGGS, 1972-73,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
For primary bibliographic entry see Field 5B.
W78-03704

MERCURY IN BENTHIC INVERTEBRATES OF THE ELBE ESTUARY,
Hamburg Univ. (West Germany). Inst. fuer Hydrobiologie und Fishchereiwissenschaft.
For primary bibliographic entry see Field 5B.
W78-03705

THE EFFECT OF COPPER ON THE EGGS AND LARVAE OF PLAICE AND HERRING,
Dunstaffnage Marine Research Lab., Oban (Scotland).
J. H. S. Blaxter.

Journal of the Marine Biology Association of the United Kingdom, Vol 57, No 3, p 849-858, 1977. 29 ref, 4 fig, 1 tab.

Descriptors: *Copper, *Fish eggs, *Larvae, *Herring, *Mortality, *Toxicity, *Fish behavior, *Feeding rates, *Growth rates, Metals, Larval growth stage, Fish physiology, *Lethal limit, Hatching, Marine fish, Clupea, Pleuronectes, *Plaice, Year-class strength, Sublethal effects.

Newly-hatched larvae of plaice (*Pleuronectes platessa* L.) showed a high mortality in 1000 microgr/l and older larvae in 300 microgr/l copper. Newly-hatched larvae of herring (*Clupea harengus* L.) also showed high mortality in 1000 microgr/l. The eggs of herring were much more sensitive, mortality being high even in 30 microgr/l. Sublethal effects of copper on feeding of plaice were evident at about 100 microgr/l in young feeding larvae but as low as 90 microgr/l in older feeding larvae. Feeding by yolk-sac plaice was totally inhibited by as little as 90 microgr/l copper. Growth and differentiation were retarded in feeding plaice larvae at 90-300 microgr/l copper. The activity of herring larvae, as shown by a laboratory-scale vertical migration, was impaired in 300 microgr/l copper. (Katz)
W78-03706

RELATIONSHIPS BETWEEN POTASSIUM PERMANGANATE TREATMENT AND WATER QUALITY,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 5G.
W78-03707

EFFECTS OF PROLONGED EXPOSURE TO AMMONIA ON FERTILIZED EGGS AND SAC FRY OF RAINBOW TROUT (SALMO GAIRDNERI),
Montana State Univ., Bozeman. Dept. of Biology.

D. E. Burkhalter, and C. M. Kaya.

Transactions of the American Fisheries Society, Vol 106, No 5, p 470-475, 1977. 36 ref, 3 fig, 1 tab.

Descriptors: *Fish eggs, *Fry, *Rainbow trout, *Mortality, *Growth rates, Fish physiology, *Fish diseases, *Toxicity, *Ammonia, *Incubation, Nitrogen compounds, Laboratory tests, Lethal limit, Hatching, Environmental effects, Water quality, Aquiculture, *Sublethal effects, *Blue-sac disease, Histological analyses.

Effects of ammonia on fertilized eggs and resulting sac fry of rainbow trout (*Salmo gairdneri*) were tested at concentrations of un-ionized ammonia ranging from 0.05 to 0.37 mg/liter (as NH3-N). Exposure was continuous throughout the incubation period and for 42 days thereafter. There was no differential egg mortality or effect on incubation period. The lowest concentration of 0.05 mg/liter NH3-N caused some retardation of early growth and development and 0.1 mg/liter caused similar but more severe effects throughout most of the test period. Hypertrophy of secondary gill lamellae epithelium occurred at 0.19 mg/liter. Karyolysis and karyorrhexis occurred in the same tissue at 0.28 mg/liter. Pale coloration and blue-sac disease occurred in sac fry at concentrations of 0.19 mg/liter and higher. The estimated incipient LC50 (lethal threshold concentration) for rainbow trout sac fry was 0.25 mg/liter NH3-N (Katz)
W78-03710

ACCUMULATION AND ELIMINATION OF PENTACHLOROPHENOL BY THE BLUEGILL, LEPOMIS MACROCHIRUS,
University of Southern Mississippi, Hattiesburg, Dept. of Biology.
G. W. Pruitt, B. J. Grantham, and R. H. Pierce, Jr.
Transactions of the American Fisheries Society, Vol 106, No 5, p 462-465, 1977. 14 ref, 2 tab.

Descriptors: *Pesticides, *Chlorinated hydrocarbons, *Absorption, *Path of pollutants, *Sunfishes, *Bioassay, *Toxicity, Food chains, Laboratory tests, Lethal limit, Gas chromatography, Herbicides, Phenolic pesticides phenols, *Pentachlorophenol, Bioconcentration, Sublethal effects, Tissue analysis.

The toxicity, accumulation, and elimination of pentachlorophenol (PCP) were investigated for the bluegill, *Lepomis macrochirus*. The 96-hour median lethal concentration (LC50) was 0.3 plus or minus 0.04 mg PCP/liter. Fish exposed to sublethal concentrations (0.1 mg/liter) accumulated PCP in various tissues from 10 to 350 times the ambient concentration. The liver had the greatest concentration followed by the digestive tract, gills, and muscle. Upon removal from PCP-containing water the contaminated fish rapidly eliminated PCP. Residues ranging from 0.03 to 0.6 ppm were still detectable, however, 16 days after fish were placed into a clean environment. (Katz)
W78-03709

ENERGETICS OF PACIFIC HERRING (CLUPEA HARENGUS PALLASI) EMBRYOS AND LARVAE EXPOSED TO LOW CONCENTRATIONS OF BENZENE, A MONOAROMATIC COMPONENT OF CRUDE OIL,
National Marine Fisheries Service, Tiburon, CA. Tiburon Lab.

M. B. Eldridge, T. Echeverria, and J. A. Whipple.
Transactions of the American Fisheries Society, Vol 105, No 5, p 452-461, 1977. 33 ref, 7 tab, 3 fig.

Descriptors: *Fish eggs, *Herrings, *Organic compounds, *Oil, *Metabolism, *Embryonic growth stage, *Respiration, *Energy budget, Laboratory tests, Hatching, Oxygen requirements, Larval growth stage, Marine fish, Commercial fish, Oil pollution, Water pollution effects, *Pacific herring, *Clupea harengus*, Sublethal effects, *Benzene, Caloric content.

Interest in life stages (las) and sure to be crude oil, amined marine larvae, and total yolk utilization. There are embryos in fold rise vase. Exogenous rot sublethal significantly believed role in later stage. W78-03710

A STUDY OF WATER FLOW Newcastle Zoology. R. H. Stobie. Comparative 58A, p 299

Descript physiolog. *Semipermeab *Toxins, Regulation *Dinitrophenol

The Na def by Na def Daphnia dinitrophenol with respect depleted medium, and some 15 h and net up at the same negative mechanism of carriers thionimom W78-03711

INVESTIGATION ENVIRONMENTAL MALDEHORATON Atlantic R. For primary W78-03712

CHLORIDE TION TO FURTHER Environmental DC. Office For primary W78-03713

RAPID FUNGICIDE Army Materiel Command For primary W78-03714

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

Interest in the energetic processes of critical early life stages of Pacific herring (*Clupea harengus pallasi*) and the potential effects from sublethal exposure to benzene, a monoaromatic component of crude oil, led to a series of experiments which examined metabolism of herring embryos, yolk-sac larvae, and post-yolk-sac larvae. Yolk caloric content was 6,020 cal/g or 1.3 calories per egg. This energy was consumed rapidly during incubation; total yolk absorption occurred 12 days after fertilization. Anabolic rates varied but at no time was there an energy deficit. Oxygen consumption of embryos increased prior to hatching, then a 10-fold rise was seen in newly hatched yolk-sac larvae. Exogenous calories were estimated from ingested rotifers and were less definable than endogenous energy due to variable grazing rates. Sublethal concentrations of benzene caused (a) significantly less embryonic tissue growth, (b) significantly greater assimilation in feeding larvae. It is believed activity of larvae played an important role in accounting for increased metabolism of later stages. (Katz) W78-03710

A STUDY OF SODIUM UPTAKE BY THE WATER FLEA *DAPHNIA MAGNA*,

Newcastle-upon-Tyne Univ. (England). Dept. of Zoology.

R. H. Stobart, J. Keating, and R. Earl. Comparative Biochemistry and Physiology, Vol 58A, p 299-309, 1977. 26 ref, 8 fig, 2 tab.

Descriptors: *Sodium, *Daphnia, Animal physiology, *Waterfleas, *Absorption, *Semipermeable membranes, *Inhibitors, *Toxins, Invertebrates, Plankton, Electrolytes, Regulation, Metabolism, Membrane processes, Laboratory tests, Biochemistry, Kinetics, *Dinitrophenol.

The Na transport mechanism (which is stimulated by Na deficiency) of the fresh-water brachiopod *Daphnia magna* is inhibited by KCN and 2,4-dinitrophenol, and exhibits saturation kinetics with respect to the external Na concentration. Na-depleted animals absorb Na from the external medium, and regain their normal Na content after some 15 hr. During net Na uptake influx, outflux, and net uptake all appear to decline exponentially at the same rate. It appears therefore that effective negative feedback operates continually upon the mechanism, which generates appreciable amounts of carrier-mediated exchange, and which resembles those of fresh-water mosquito and chironomid larvae. (Katz) W78-03711

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: FORMALDEHYDE,

Atlantic Research Corp., Alexandria, VA. For primary bibliographic entry see Field 5B. W78-03714

CHLORDANE AND HEPTACHLOR IN RELATION TO MAN AND THE ENVIRONMENT. A FURTHER PESTICIDE REVIEW 1972-1975, Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.

For primary bibliographic entry see Field 5B. W78-03715

RAPID BIOASSAY FOR WATER SOLUBLE FUNGITOXICANTS,

Army Mobility Equipment Research and Development Command, Fort Belvoir, VA. For primary bibliographic entry see Field 5A. W78-03716

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: ACRYLAMIDES,

Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.

For primary bibliographic entry see Field 5B. W78-03717

ACUTE AND CHRONIC PARATHION TOXICITY TO FISH AND INVERTEBRATES,

Environmental Research Lab., Duluth, MN. A. Spacie.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 800, Price codes: A06 in paper copy, A01 in microfiche. EPA Report, 1976. 106 p, 53 tab, 8 fig, 46 ref. 18050 HQG.

Descriptors: *Toxicity, *Bioassay, Freshwater fish, *Daphnia, Aquatic insects, Midges, Crustaceae, *Organophosphorus insecticides, Invertebrates, *Sunfishes, *Brook trout, Minnows, Enzymes, Fish physiology, Fish eggs, Mortalities, Pesticides, Water pollution effects, Juvenile fish, *Lethal dosage, *Acetylcholinesterase, *Parathion, Nervous system, Bluegill sunfish, Lepomis, Salvelinus, Fathead minnow, Pimephales, Scud, Gammarus, Chironomus.

Acute and chronic toxicities of parathion (0,0-diethyl 0, p-nitrophenyl phosphorothioate) were found for bluegill, brook trout, fathead minnow, water flea, scud, and midge. The 96-hour LC₅₀ values were: bluegill - 0.51 mg/l, trout - 1.76 mg/l, minnow 1.6 to 0.5 mg/l, water flea - 0.63 microg/l, scud - 0.4 microg/l and midge - 31 microg/l. Deficiencies and depressed acetylcholinesterase were found in bluegills above 0.17 microg/l after 23 months exposure. Trout showed no ill effects at 7.2 microg/l but trout eggs had reduced hatchability at 32 microg/l. Minnows had reduced egg production and deformities at about 4 microg/l in 8/12 months. Bluegills had parathion residues of 5 to 25 times the chronic water concentrations, trout had several hundred times, and minnows had residue levels intermediate to the tow other species. Chronically exposed fish appeared to be most sensitive to parathion at the juvenile or adult stages. The chronic no-ill-effect level for water flea was 0.08 microg/l, for scud less than 0.04 microg/l, and for midge, less than 3.1 microg/l. (Katz) W78-03718

BASELINE STUDY OF TRACE HEAVY METALS IN BIOTA OF PUGET SOUND,

Washington Univ., Seattle. Coll. of Fisheries. For primary bibliographic entry see Field 5A. W78-03719

PESTICIDAL ASPECTS OF CHLORDANE IN RELATION TO MAN AND THE ENVIRONMENT,

Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.

For primary bibliographic entry see Field 5B. W78-03721

ASSESSMENT OF EFFECTS OF ALTERED STREAM FLOW CHARACTERISTICS ON FISH AND WILDLIFE. TASK 3: ANALYSIS OF CASE STUDY FINDINGS, IDENTIFICATION OF PROBLEMS, AND RECOMMENDATION OF REMEDIES,

Enviro Control, Inc., Rockville, MD.

W. Nelson, G. Horak, M. Lewis, and J. Colt.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 470, Price codes: A07 in paper copy, A01 in microfiche. Final Report to Fish and Wildlife Service, Ft. Collins, Colo., August 1976. 128 p, 34 tab, 8 fig.

Descriptors: *Oregon, *Washington, *Idaho, *Colorado, *New Mexico, *Utah, *Wyoming, *Arizona, Dams, *Flow control, Water resources

development, Streamflow, *Water quality control, Pacific Northwest U.S., Rocky Mountain Region, Fish barriers, Fisheries, Flow rates, On-site investigations, *Instream flow, *Montana.

This report contains analysis, findings, conclusions, and recommendations regarding changed flow regimes below dams, the impact on fisheries and methodologies used to assess flow requirements for 96 dams and diversions in the Rocky Mountain and Pacific Northwest Regions. (Katz) W78-03722

EFFECTS OF ANTIMYCIN A AND ROTENONE ON MACROBENTHOS IN PONDS,

Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.

L. J. Houf, and R. S. Campbell.

Investigations in Fish Control, No. 80, 1977. Department of the Interior, Fish and Wildlife Service, 29 p, 15 ref, 22 fig, 10 tab.

Descriptors: *Rotenone, *Antimycin A, *Antibiotics(Pesticides), *Diptera, *Pesticides, *Benthic fauna, *Aquatic populations, *Fish control agents, *Toxicity, *Insects, Mayflies, Dragonflies, Caddisflies, Midges, Snails, Organic pesticides, Seasonal, Benthos, Dissolved oxygen, Ponds, Aquatic habitats, Invertebrates, On-site investigations, Fish food organisms, Species diversity, Emergence, Abundance.

Samples of macrobenthos, collected over a 14-month period from nine 0.03-ha experimental ponds at the Fish-Pesticide Research Laboratory, Columbia, Missouri, were analyzed to determine the long- and short-term effects of antimycin A and rotenone. The ponds were characterized by an abundance of bushy pondweed (*Najas guadalupensis*) and by the absence of fish. Treatment concentrations of 0.5 mg/l of rotenone and 20 microg/l of antimycin and concentrations of 2.0 mg/l of rotenone and 40 microg/l of antimycin were applied. There were no effects on species diversity, emergence, seasonal dynamics, abundance, or relative numbers of taxa that could be attributed to either toxicant. Periods of spring emergence, summer buildup, and fall emergence of insects were closely associated with the seasonal development and decline of vegetation. (Katz) W78-03724

AQUATIC MACROINVERTEBRATES IN A SMALL WISCONSIN TROUT STREAM BEFORE, DURING, AND TWO YEARS AFTER TREATMENT WITH THE FISH TOXICANT ANTIMYCIN,

Wisconsin Univ.-Stevens Point. Coll. of Natural Resources.

Z. G. Jacobi, and D. J. Degan.

Investigations in Fish Control, No. 81, 1977. Department of the Interior, Fish and Wildlife Service, 24 p, 19 ref, 8 fig, 9 tab.

Descriptors: *Biomass, *Benthic fauna, *Insects, Seasonal, *Fish control agents, *Antimycin A, *Piscicides, *Invertebrates, *Diptera, *Aquatic populations, Benthos, Invertebrates, Mayflies, Caddisflies, Fish food organisms, Crayfish, On-site investigations, Snails, Stoneflies, Wisconsin, *Seas Branch Creek(Wis).

Benthos and benthic drift were sampled periodically in Seas Branch Creek (Vernon County, Wisconsin) for 5 months before and for 2 years after the stream was treated with antimycin, and over the same period in nearby untreated Maple Dale Creek. During treatment antimycin concentrations varied from 17 to 44 microg/l at the two sampling stations in Seas Branch Creek. Populations of macroinvertebrates were drastically reduced 2 days after treatment, but all common taxa identified before treatment were present in the stream 1 year later. Estimated biomass reductions of living organisms 2 days after treatment

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

were as high as 50% for one caddis fly, *Hydropsyche* sp., and 75% for another, *Brachycentrus americanus*, 70% for a crane fly, *Antocha* sp.; and nearly 100% for a mayfly, *Baetis cingulatus*, and a scud, *Gammaurus pseudolimnaeus*. Summer biomass of *Antocha* and *Brachycentrus* did not regain pretreatment levels during the second year. The mortality of the riffle beetle, *Optioservus fastidius*, was approximately 20% 9 days after treatment. A crayfish, *Oreconectes propinquus*, was not affected by the treatment. The biomass of *Gammaurus*, *Prosimulium* (a black fly), *Baetis*, and *Hydropsyche* was high during both summers after treatment. After 1 year, and continuing into the second year, total benthic biomass approached or exceeded that before treatment. (Katz)
W78-03725

CHLORINE-INDUCED MORTALITY OF EGGS AND LARVAE OF SPOTTED SEATROUT (CYNOSCIUS NEBULOSUS),
National Marine Fisheries Service, Port Aransas, TX. Port Aransas Lab.
A. G. Johnson, T. D. Williams, and C. R. Arnold. Transactions of the American Fisheries Society, Vol. 106, No. 5, p 466-469, 1977. 15 ref, 1 tab.

Descriptors: *Larvae, *Fish eggs, *Mortality, *Lethal limit, *Toxicity, *Chlorine, *Water pollution effects, *Marine fish, *Estuarine environment, Larval growth stage, Commercial fish, Laboratory tests, Water pollution sources, Chlorination, *Chloramine, 5-Chlorouracil, *Spotted seatrout, *Cynoscion*, Sodium hypochlorite.

The acute lethal effects of sodium hypochlorite, chloramine, and 5-chlorouracil on eggs and larvae of spotted seatrout, *Cynoscion nebulosus*, are presented. Forty-eight-median tolerance limits (TL₅₀) for the various toxicants and age classes (2-h-old eggs, 10-h eggs, and 1-h posthatch larvae) were, respectively: sodium hypochlorite-0.21 ppm plus or minus 0.01, 0.21 ppm plus or minus 0.01, 0.17 ppm plus or minus 0.28 ppm; chloramine-14.14 ppm plus or minus 1.13, 0.57 ppm plus or minus 0.28, 5.75 ppm plus or minus 3.01 ppm; 5-chlorouracil-8.91 plus or minus 1.03, greater than 100, 79.43 plus or minus 44.97 ppm. The 48-h TL₅₀ varied depending on toxicant and age class. (Katz)
W78-03726

EFFECTS OF THERMOCYCLES ON BODY WEIGHT GAIN AND GONADAL GROWTH IN THE GOLDFISH, CARASSIUS AURATUS,
Milwaukee Public Museum, WI.
R. E. Spieler, T. A. Noeske, V. deVlaming, and A. H. Meier. Transactions of the American Fisheries Society, Vol. 106, No. 5, p 440-444, 1977. 8 ref, 7 tab, 2 fig.

Descriptors: *Water temperature, *Growth rates, Aquaculture, Cycles, *Environmental effects, *Heated waters, *Sexual maturity, *Photoperiodism, Temperature, Aquatic environment, Productivity, Biorhythms, Fish physiology, *Carassius auratus*, *Thermocycles, Gonadal growth, *Goldfish.

Goldfish subjected to increased temperatures at one of six different times of day had significant differences in weight gain and testicular growth depending on the time of treatment. Depending on the time of day the thermocycle was initiated, weight gain and testicular growth could be either stimulated, inhibited, or equal to that in fishes subjected to constant heat or constant cold. Heat applied during the last 4 h of darkness was particularly conducive to weight gain and testicular growth. The results of this study may have important implications for aquaculture. (Katz)
W78-03727

DEPTH DISTRIBUTION OF ADULT CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) IN RELATION TO SEASON AND GAS-SUPER-SATURATED WATER,
Battelle Pacific Northwest Labs., Richland, WA.
R. H. Gray, and J. M. Haynes. Transactions of the American Fisheries Society, Vol. 106, No. 6, p 617-620, 1977. 29 ref, 2 tab.

Descriptors: *Seasonal, *Tracking techniques, *Chinook salmon, *Supersaturation, *Fish behavior, Depth, Aquatic environment, Gases, *Fish diseases, Dams, Remote sensing, Salmon, Hydrostatic pressure, Fish migration, Water properties, Environmental effects, *Snake River (Wash), Radio transmitters, *Gas bubble disease.

Pressure-sensitive radio transmitters were used to determine swimming depths of adult chinook salmon in relation to season and gas-supersaturated water in the lower Snake river, southeastern Washington. Thirty radio-tagged fish, 15 with external and 15 with internal transmitters, were monitored in supersaturated water in spring 1976. Nine fish with internal and 30 with external transmitters were monitored in the absence of supersaturation in fall 1976 and spring 1977 respectively. Spring chinook salmon spent about 89% of their time below the critical supersaturation zone in 1976. Swimming depths of fall 1976 and spring 1977 chinook, migrating in normally saturated water, were shallower and differed significantly from those of fish migrating in supersaturated water in spring 1976. (Katz)
W78-03730

THE DIFFERENTIAL EFFECTS OF FREE AND COMBINED CHLORINE ON JUVENILE MARINE FISH,
Woods Hole Oceanographic Institution, MA.
J. M. Capuzzo, J. A. Davidson, S. A. Lawrence, and M. Libni. Estuarine and Coastal Marine Science, Vol. 5, p 733-741, 1977. 20 ref, 2 tab, 4 fig.

Descriptors: *Chlorine, *Bioassay, *Mortality, *Killifishes, *Juvenile fish, *Fish behavior, *Toxicity, *Metabolism, Laboratory tests, Behavior, Lethal limits, Water pollution effects, Temperature, Marine fish, *Pseudopleuronectes*, *Stenotomus*, *Fundulus*, *Scup*, *Flounder, Sublethal effects, Combined chlorine.

The differential effects of free chlorine and chloramine on three species of juvenile marine fish have been investigated in continuous flow bioassay units. The toxicity of both chlorine forms to winter flounder, scup, and killifish, appeared to be a threshold effect: an abrupt increase in mortality was observed over a narrow range of toxicant concentrations. The three species were similar in their responses to free chlorine, the more toxic of the two chlorine forms. However, there was a difference in chloramine toxicity among the three species tested; killifish were more susceptible than either of the other two species, probably reflecting differences in metabolic regulation or uptake rates. Behavioral aberrations-distended gills and erratic swimming behavior-of winter flounder and scup and significant reductions in standard respiration rates of killifish were observed with exposure to chlorine and chloramine concentrations approaching lethal levels. (Katz)
W78-03729

PREDATION ON HARD CLAM (MERCENARIA MERCENARIA) POPULATIONS,
National Marine Fisheries Service, Highlands, NJ.
Sandy Hook Sport Fisheries Marine Lab.
C. L. MacKenzie, Jr. Transactions of the American Fisheries Society, Vol. 106, No. 6, p 530-537, 1977.

Descriptors: Aquatic populations, *Clams, *Food webs, *Predation, *Commercial shellfish, *Crabs, *Productivity, Laboratory tests, On-site investigations, Competition, Crustaceans, Invertebrates, Pest control, Balance of Nature, *Pesticides, Water pollution effects, *Sevin.

Predation on hard clams (*Mercenaria mercenaria*) was examined in laboratory experiments and in wild populations. Increases in clam density following predator reduction was also examined. The principal predators of hard clams are gastropods and crabs, which take mostly small clams. In the laboratory, crabs consume clams rapidly. Wild populations of clams are most abundant in areas where either predators are scarce or stones provide cover from them. Variations in recruitment and predation on clams smaller than about 15 to 20 mm determine the strength of year classes. As clams grow, they become less vulnerable to a succession of predators, first outgoing mud crabs at a length of about 7 mm, rock crabs at about 15 mm, oyster drills at about 20 mm, and moon snails at about 50 mm. Clam densities were seven and eight times as great in sections of shellfish beds where predators were reduced by pesticide applications compared with untreated sections of the same beds. (Katz)
W78-03730

FOOD AND FEEDING BEHAVIOR OF THE SHOVELNOSE STURGEON, SCAPHIRHYNCHUS PLATORYNCHUS, IN THE UNCHANNELIZED MISSOURI RIVER, SOUTH DAKOTA,
University of Southern Mississippi, Hattiesburg, Dept. of Biology.

T. Modde, and J. C. Schmulbach. Transactions of the American Fisheries Society, Vol. 106, No. 6, p 602-608, 1977.

Descriptors: *Fish behavior, *Feeding rates, *Missouri River, *Diptera, *Fish diets, Seasonal, River flow, *Fish food organisms, *Forage fish, *Benthos, Freshwater fish, Foods, Aquatic insects, Velocity, Rivers, On-site investigations, Mayflies, Biomass, Temperature, Environmental effects, Movement, South Dakota, *Scaphirhynchus*, *Sturgeon, *Lewis and Clark Reservoir, Feeding behavior.

The feeding habits of the shovelnose sturgeon (*Scaphirhynchus platorhynchus*) were investigated in the unchannelized Missouri River, South Dakota. The annual diet was dominated by aquatic arthropods, particularly larvae of the insect orders Trichoptera, Diptera, and Ephemeroptera. The annual feeding behavior was separated into three intervals: (1) the fall months, during which the fish extensively utilize the major components of the drift; (2) the winter period, characterized by exploitation of a greater diversity of aquatic and terrestrial invertebrates; and (3) the late spring and summer interval, in which feeding was restricted to benthic foraging. Electivity values indicated opportunistic feeding activity. Shifts of feeding activity were influenced by timing and rates of discharge from the Lewis and Clark Reservoir located upriver. Changes in the elevation and velocity of the water mass appeared to affect the vulnerability of prey organisms. (Katz)
W78-03731

CHRONIC ORAL TOXICITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD) TO RAINBOW TROUT,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forest Services Lab.
C. L. Hawkes, and L. A. Norris. Transactions of the American Fisheries Society, Vol. 106, No. 6, p 641-645, 1977. 2 fig, 2 tab, 10 ref.

Descriptors: *Toxicity, *Rainbow trout, *Bioassay, *Herbicides, *Brush control, *Growth rates, *Feeding rates, *Mortality, *Pesticide residues, *Chlorinated hydrocarbon pesticides,

Trout, behavior effects, sis, *Die

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

Trout, Salmonids, Path of pollutants, Fish behavior, 2,3,5nT, Fish diseases, Water pollution effects, *TCDD, Sublethal effects, Tissue analysis, *Dioxin.

Rainbow trout (*Salmo gairdneri*) consumed diets containing 2.3 parts per trillion (10 to the -12 power pptr), 2.3 parts per billion (10 to the -9 power, ppb), and 2.3 ppm TCDD 6 days each week for 105 days, resulting in an average intake of, respectively, 3.2×10^{-10} to 8×10^{-9} power, 3.6×10^{-10} to 5×10^{-9} power, or 2.1×10^{-10} to 2×10^{-9} power microgr/TCDD/g fish, freeze-dry weight per day. Consumption of food containing 2.3 pptr or 2.3 ppb TCDD caused no mortality, no reduction in food consumption or growth, and no fin erosion. Consumption of diets containing 2.3 ppm TCDD caused an average mortality of 50% and 88% in 61 and 71 days, respectively. Feeding activity and growth were also reduced, and fin erosion and liver pathology increased. These data indicates that the 'no-effect' level for survival, growth, feeding activity, and fin erosion in rainbow trout receiving TCDD orally is between 2.3 ppm and 2.3 ppb. (Katz)
W78-03733

PHOSPHOROUS FERTILIZATION OF SUNFISH PONDS,
Auburn Univ., AL. Department of Fisheries and Allied Aquacultures.
F. Lichtkoppler, and C. E. Boyd.
Transactions of the American Fisheries Society, Vol. 106, No. 5, p 634-636, 1977. 5 ref, 2 tab.

Descriptors: *Phosphorous, *Sunfishes, *Aquiculture, *Fertilization, *Productivity, *Primary productivity, *Ponds, Fish farming, Fertilizers, Food chains, Aquatic algae, Aquatic productivity, Nutrients, Fish management.

Phosphorus fertilization rates were reduced from 9 to 4.5 kg/hectare/application of P2O5 in ponds on a wooded watershed without significant decline in sunfish population production. Evaluation of the present and an earlier study suggests that 9 kg/hectare/application of P2O5 be used for woodland ponds with heavy fishing pressure, while 4.5 kg/hectare/application is suitable for woodland ponds subject to less fishing. (Katz)
W78-03734

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES, PROCEEDINGS OF THE SECOND U.S.-JAPAN EXPERTS MEETING, OCTOBER 1976-TOKYO, JAPAN.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.
W78-03735

AN EXPERIMENT IN REMOVAL OF ORGANICALLY POLLUTED BOTTOM MUD FROM THE SETO INLAND SEA,
Nansei Regional Fisheries Research Lab., Hiroshima (Japan).
For primary bibliographic entry see Field 5G.
W78-03738

THE MECHANISM OF MERCURY ACCUMULATION IN FISH,
Tsukuba Univ., Ibaraki (Japan). Dept. of Environmental Epidemiology.
For primary bibliographic entry see Field 5B.
W78-03739

HYDRAULIC DREDGING AS A LAKE RESTORATION TECHNIQUE: PAST AND FUTURE,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.
W78-03747

INTERCHANGE OF NUTRIENTS AND METALS BETWEEN SEDIMENTS AND WATER DURING DREDGED MATERIAL DISPOSAL IN COASTAL WATERS.

Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W78-03748

DREDGING CONDITIONS INFLUENCING THE UPTAKE OF HEAVY METALS BY ORGANISMS,

Army Engineer District, San Francisco, CA.
For primary bibliographic entry see Field 5B.
W78-03749

ECOLOGICAL CONSIDERATIONS IN SITE ASSESSMENT FOR DREDGING AND SPOILING ACTIVITIES,

Environmental Research Lab., Narragansett, RI.
D. K. Phelps, and A. C. Myers.
In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts - Meeting - October 1976, Tokyo, Japan. EPA-600/3-77-083. July 1977, p 266-286. 10 fig, 7 tab.

Descriptors: *Water pollution effects, *Bottom sediments, *Dredging, *Environmental effects, *Benthos, *Water quality control, Analytical techniques, *Absorption, *Metals, *Sediment-water interface, *Path of pollutants, Invertebrates, Biological communities, Lead, Sediments, Cadmium, Copper, Zinc, Trace elements, *Narragansett Bay(Rhode Island).

The results of a series of studies which are aimed at the identification of methods that give the most expeditious yet meaningful demonstration of possible negative environmental impacts from disposal of contaminated sediments into clean marine systems are presented. Comparisons have been made of sediments, faunal diversity, and animal tissue residues between highly contaminated and clean benthic systems. The nature of the area of study is such that a series of field stations along a gradient of benthic systems ranging from highly contaminated to a clean system proved helpful. Laboratory tests were made with animals and sediments. Results demonstrate that a contaminated sediment disposed of in a clean environment will tend to degrade quality of the overlying water column. The benthic system, once contaminated, provides a major reservoir of contaminants which continue to be exchanged with the overlying water column. It is recommended that responses, such as feeding rate and carbon fixation of organisms from contaminated and uncontaminated areas be examined. (See also W78-03735) (Katz)
W78-03751

ROTIFER SENSITIVITY TO COMBINATIONS OF INORGANIC WATER POLLUTANTS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies; and Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. L. Buikema, Jr., C. L. See, and J. Cairns, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 123. Price codes: A03 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin 92, December 1977. 42 p, 4 tab, 12 fig, 79 ref. OWRT A-071-VA(1).

Descriptors: *Rotifers, Invertebrates, *Toxicity, *Inorganic compounds, *Bioassay, Water pollution effects, Pollutant identification, Chlorine, Copper, Chromium, Fluorides, Iron, Zinc, Metal complexes, Hazard assessment(Pollution).

This research assesses the toxicity of interactions of selected inorganic compounds to the rotifer *Philodina acuticornis*. Bioassays were conducted in a synthetic dilution medium under static condi-

tions. Effective concentrations of the compounds that produced rotifer mortality were determined by recording, after 24 and 48 hours, the number of dead or withdrawn animals in triplicate samples. Results indicate a range of rotifer response to these compounds, from supra-additive (synergistic) to antagonistic. The interaction of chromium and chlorine was supra-additive. Additive interactions were observed for mixtures of chromium and fluoride, copper and chromium, and copper and chlorine; the interaction of copper and chromium fluctuated along the line of additivity. Combinations of iron and chlorine, iron and fluoride, zinc and fluoride, and chloride and fluoride produced antagonistic responses. No interactions were observed for mixtures of zinc and copper and copper and fluoride. The interaction of zinc and chlorine was unique: the effect was infra-additive below a 50:50 mixture and antagonistic above this mixture. Zinc was most toxic in high concentrations, and as the concentrations of chlorine increased, rotifer sensitivity decreased, probably because of the formation of metal complexes.
W78-03754

STRUCTURE OF LEECH GROUPS (HIRUDINEA) IN POLLUTED PARTS OF THE CATCHMENT AREA OF THE RIVERS BZURA AND NER, PART I. FIELD INVESTIGATION,

Instytut Kształcenia Nauczycieli i Badan Oświatowych, Łódź (Poland).

K. Matysiak.

Acta Hydrobiologica, Vol 18, No 3, p 259-276, 1976. 5 fig, 4 tab, 23 ref.

Descriptors: *Water pollution effects, *Bzura River(Poland), *Ner River(Poland), *Leeches, *Systematics, Watersheds(Basins), Hirudinea, Poland, Tributaries, Rivers, River beds, Annelids.

Leech fauna (Hirudinea) in the longitudinal profile of the Rivers Bzura and Ner (Poland) as well as in certain tributaries and old riverbeds, were studied in relation to the degree of water pollution. Some 3,269 specimens of 12 species, caught at 37 stations, were analyzed and classified using ecological methods. No leeches were found at 14 stations due to severe water pollution. In the River Bzura 2,219 individuals representing 10 species were found, and in the upper sector of the Ner 366 specimens of seven species were caught. In old riverbeds seven species (505 specimens) were caught, and in Bzura tributaries six species (179 specimens) were found. Species were assigned to two groups on the basis of their concomitant or separate occurrence: (1) *Haemopis sanguisuga*, *Glossiphonia complanata*, *Helobdella stagnalis*, and *Erbpobdella negricollis*; (2) *Hemiclepsis marginata* and *Erbpobdella testacea*. Five species did not fit into either group: *Erbpobdella testacea*. Five species did not fit into either group: *Erbpobdella monostriata*, *Dina lineata*, *Glossiphonia heterocrota*, *Theromyzon tessulatum*, and *Piscicola geometra*. Stations were likewise categorized by similarities. Relationships between groups of species and single species, and groups of stations and single stations are presented in a synthetic diagram. Similarity of stations is conditioned by the occurrence of eurytopic species tolerating a high degree of water pollution, living in different environmental conditions. (Lynch-Wisconsin)
W78-03814

COMPUTERIZED ANALYSIS OF STREAM ALGAE,

Uppsala Univ. (Sweden).

B. Klasvik.

Vaxtekologiska studier, 1974. 100 p, 19 fig, 31 tab, 50 ref.

Descriptors: *Algae, *Trophic levels, *Eutrophication, *Oligotrophy, *Verkean River(Sweden), *Kaltisjökk Brook(Sweden), Computer models, Seasonal, Rivers, Streams, Ecosystems, Periphyton, Currents(Water), Baseline studies, Statistical methods.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Two Swedish streams of the *Vaucheria* (eutrophic) and *Zygnuma* (oligotrophic) types were investigated for types and amounts of benthic algae, seasonal variation, and their relationship to certain environmental factors. The Verkean River is a *Vaucheria* stream in southern Sweden, while Kaltisjok Brook is an oligotrophic stream in Swedish Lapland. Only two abundant macroscopic species, *Draparnaldia mutabilis* and *Lemanea fluviatilis*, and four abundant microscopic species, *Achnanthus minutissima*, *Gomphonema parvulum*, *Chamaesiphon fuscus*, and *Hydrurus foetidus*, were common to both streams. Except at one station with lower water hardness and pH, the *Eutonia* group was absent in the Verkean, but dominant in the Kaltisjokk. The *Nitzschia* group was almost entirely absent in the Kaltisjokk, inferring that most species of this group may be heterotrophic in organic nitrogen compounds, and do not thrive in oligotrophic, unpolluted waters. Algal growth on plastic foils used as artificial substrates proved valuable for recording trophic level and evaluating factors which promote algal growth. In the Verkean an average 250,000 organisms per sq cm colonized the foil, compared with a maximum 50,000 per sq cm in the Kaltisjokk. Growth density differences appear to reflect nutritional standards in the two streams. Computer analyses included stepwise discriminant analysis and multivariate analysis of variance. (Lynch-Wisconsin) W78-03815

PHYTOPLANKTON AND ENVIRONMENTAL FACTORS IN LAKE HJALMAREN, 1966-1973,
National Swedish Environment Protection Board,
Uppsala. Limnological Survey.
E. Willen.
SNV PM 718, NLU Rapport 87, 1976. 89 p, 29 fig,
3 tab, 92 ref.

Descriptors: *Phytoplankton, *Eutrophication, *Algae, *Baseline studies, *Lake Hjalmaren(Sweden), Lakes, Data collection, Agricultural runoff, Water pollution, Nutrients, Biomass, Chlorophyll, Phosphorus, Sewage effluents, Primary productivity, Circulation, Species diversity.

Phytoplankton species composition and diversity, biomass, and production were studied in Lake Hjalmaren, Sweden's fourth largest lake, during 1966-73. Water chemistry, bacteria, macrophytes, attached algae, phytoplankton (including chlorophyll-a) primary production, zooplankton, benthic fauna, and fisheries were investigated in the shallow, eutrophic lake which has a mean depth of 6 m, greatest depth of 20 m, length of 60 km, width of 20 km, and a drainage area of 4,000 sq km. Four main basins comprise the lake--Hemfjarden, Mellanfjarden, Storhjalmaren, and Ostra Hjalmaren--separated by islands and narrow sounds. Oxygen supply is good, due to constant water circulation. Nutrient concentrations decrease from west to east, with highest concentrations near Orebro. Total nitrogen range is 0.62-2.17 mg/l, total phosphorus 0.03-0.26 mg/l, nitrogen loading 4.1-30.0 g/sq m/yr, and phosphorus loading 0.2-3.0 g/sq m/yr. A total of 330 species of phytoplankton were found, dominated by blue-green algae, diatoms, and green algae. Species diversity in Hemfjarden was much higher (4.13) than in Storhjalmaren (2.34), although the former is the more highly polluted; constantly circulating water provides a steady nutrient supply and prevents blue-green algae shading. Phosphorus precipitation began in 1975 at the Orebro sewage treatment plant is expected to decrease phytoplankton biomass and limit algal blooms in the western basins. (Lynch-Wisconsin) W78-03816

LIMNOLOGICAL STUDIES IN A LARGE, DEEP, OLIGOTROPHIC LAKE (LAKE OHRID, YUGOSLAVIA): SEASONAL AND ANNUAL PRIMARY PRODUCTION DYNAMICS OF THE PELAGIAL PHYTOPLANKTON,
Hidrobioloski Zavod, Ochrida (Yugoslavia).

B. T. Ocevski, and H. L. Allen.
Archiv fur Hydrobiologie, Vol 79, No 4, p 429-440, May 1977. 6 fig, 1 tab, 7 ref.

Descriptors: *Period of growth, *Oligotrophy, *Phytoplankton, *Radioactive dating, *Lake Ohrid(Yugoslavia), Lake stages, Primary production, Limnology, Seasonal, Annual, Lakes.

Carbon-14 light and dark bottle measurements of pelagic phytoplankton production were estimated in the vertical column of Lake Ohrid, Yugoslavia during 1972-73. Lake Ohrid is a large, calcareous, graben lake of probable Pliocene origin located in southwestern Yugoslavia. In spite of its probable age, it has been characterized as highly oligotrophic. As part of a larger comprehensive and intensive limnological study of the lake, in which nutritional factors governing the phytoplankton were also evaluated by sensitive carbon-14 methods, annual production of the pelagic phytoplankton was monitored to establish vertical, seasonal and annual production dynamics that could then be used to compare production in Lake Ohrid to existing published production data from other large lakes. Annual mean production was calculated for 1973 and compares favorably with other published data on annual mean production rates for oligotrophic lakes. The apparent low mean annual production rate for Lake Ohrid appears to be controlled by a host of interacting chemical-physical factors which effectively restrict the potential openwater phytoplankton productivity. (Coyle--Wisconsin) W78-03820

S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO THE NEW YORK STATE WATER RESOURCES,
Calspan Corp., Buffalo, NY.

For primary bibliographic entry see Field 5A.
W78-03822

ALGAL NUTRIENT AVAILABILITY AND LIMITATION IN LAKE ONTARIO DURING IFYGL, PART I. AVAILABLE PHOSPHORUS IN URBAN RUNOFF AND LAKE ONTARIO TRIBUTARY WATERS,
Texas Univ. at Dallas, Richardson.
W. F. Cowen, and G. F. Lee.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-262 974, Price codes: A11 in paper copy, A01 in microfiche. Report No. EPA-600/3-76-094a, October 1976. 216 p, 23 fig, 64 tab, 94 ref. EPA-600/3-76-094a, R-800537-02.

Descriptors: *Lake Ontario, *Phosphorus, *Tributaries, *Urban runoff, *Madison(WI), *Genesee River Basin(NY), Wisconsin, New York, Snow, Algae, Nutrients, Eutrophication, Great Lakes, IFYGL, *Selenastrum capricornutum*, Nutrient availability.

Urban runoff in Madison, Wisconsin was analyzed to determine the availability of various phosphorus forms for algal growth, and methods for urban systems were applied to phosphorus availability in Lake Ontario tributary waters. Total phosphorus, soluble phosphorus, particulate phosphorus, and soluble reactive forms were measured. Data for the Madison experiments were gathered at eight city locations between August 1972-March 1973; the test alga was *Selenastrum capricornutum*. Based on the Madison data, plus rain gauge samples from 13 New York State locations, water samples from streams in the Genesee River Basin, and samples from four Lake Ontario tributaries in New York State, it was concluded that only about 20% of insoluble orthophosphate present in surface water drainage is available for algal growth. Recommendations are: (1) phosphorus available to aquatic plants as inputs into a water course can be computed by adding together soluble orthophosphate and 20% of insoluble orthophosphate; and (2) ion exchange in-

cubation and algal assay techniques (used in this study) should be used to evaluate potentially available phosphorus in studies of all major U.S. rivers prior to designing a national phosphate control program. (Lynch-Wisconsin) W78-03824

ACTINOMYCETE DISTRIBUTION IN NORTHERN GREEN BAY AND THE GREAT LAKES, TASTE AND ODOR RELATIONSHIPS IN EUTROPHICATION OF NEARSHORE WATERS AND EMBAYMENTS,
Michigan Dept. of Natural Resources, East Lansing.

D. P. Tierney, R. Powers, T. Williams, and S. C. Hsu.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 551, Price codes: A09 in paper copy, A01 in microfiche. Report No EPA-905/9-74-007, July 1976. 167 p, 31 fig, 34 tab, 59 ref, 6 append. 68-01-1885.

Descriptors: *Taste, *Odor, *Actinomycetes, *Great Lakes, *Green Bay(Lake Michigan), Bays, Eutrophication, Nutrients, Trophic levels, Phytoplankton, Lake Michigan, Michigan, Water pollution, Water pollution sources, Water pollution effects, Bacteria, Streptomyces.

Earthy-musty odors and tastes reported in Green Bay and other parts of the Great Lakes were traced to increases in populations of the bacterial genus Streptomyces, an actinomycete. Laboratory tests showed that actinomycete concentrations are higher in nutrient-enriched waters. Actinomycetes can use a variety of organic substances as carbon sources, including phenol, cellulose, effluents from secondary municipal wastewater treatment plants or paper mills, and dead algal cells. Surveys of actinomycete population structure, abundance, and history of odor problems were conducted from April-October 1974 at eight Michigan stations in northern Green Bay; hydrochemistry and phytoplankton surveys of northern Green Bay were also conducted to assess trophic status. Questionnaire data were gathered on taste and odor problems in other Michigan communities using Great Lakes water. Untreated water samples were obtained from 26 Municipal water supply facilities in Michigan. It is recommended that both organic and inorganic nutrient inputs to the Great Lakes should be reduced to the lowest practicable level, thus directly and indirectly regulating actinomycete population growth. (Lynch-Wisconsin) W78-03820

BACTERIAL COENOSSES OF WATER AND BOTTOM SEDIMENTS OF THE FISHERY PONDS IN THE UKRAINIAN SSR, (IN RUSSIAN),
Ukrainian Research Inst. of the Fish Industry, Kiev (USSR).
A. F. Antipchuk.
Gidrobiol Zb 9(4), p 5-13, 1973.

Descriptors: *Bacteria, *Bottom sediments, Algae, *Bacterial coenoses, Fertilizers, Fisheries, Forests, Microbes, Minerals, Ponds, Steppe Zones(USSR), *Ukrainian-SSR, Vegetation, Water pollution.

A study carried out in 1967-1968 in the nursery ponds, situated in forest, forest-steppe and steppe zones of the Ukraine (USSR), showed a remarkable increase of bacterial density with depth. Mineral fertilizer application, together with slack lime, decidedly affects the density and pattern of these coenoses. Zonality in the occurrence of some microbial forms has been observed. The density of bacterial cover decreased toward the end of the vegetation (primarily algae) period. (Copyright 1975, Biological Abstracts, Inc.) W78-03829

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

FLORA AND FAUNA IN FRESHWATER BODIES OF THE THALA HILLS OASIS (ENDERBY LAND, EASTERN ANTARCTICA), Polish Academy of Sciences, Warsaw. Inst. of Experimental Biology.

K. W. Opalinski.

Pol Arch Hydrobiol. 19(4), p 383-398, 1972. (Polish sum.).

Descriptors: Lakes, *Antarctic oasis, *Antarctica, *Bacteria, Birds, Chlorophyta, Chlorosphaera antarctica, *Cyanophyta, *Diatoms, Hypsibius chilensis, Lepadella patella, Navicula seminulum, Nematoda, Oedogoniales, Phormidium, Phormidium glacieae longiarticulata, Pinnularia gibba var parva, Plankton, Protozoa, Rotatoria, Schizothrix antarctica, Tardigrada, Water pollution.

The composition of flora and fauna in several freshwater lakes of the Antarctic oasis Thala Hills (67 degrees 40 minutes S, 45 degrees 50 minutes E), Enderby Land, Eastern Antarctica is discussed. Water bodies were selected which were not yet disturbed by man (pollution, changes in water intake, etc.). In the Antarctic freshwater lakes, most living organisms concentrate in the bottom layer where the so-called bacterio-algal substratum is formed. The main elements of that layer consists of various species of Phormidium (Cyanophyta), as well as bacteria and Diatomae. Animals are also connected with that layer. Plankton in the Antarctic lakes is very poor, consisting mainly of Diatomae. In the lakes of the Thala Hills oasis there are 5 spp. of Protozoa, 3 spp. of Rotatoria, 2 spp. of Tardigrada and Nematoda (species not determined). The flora of the lakes is represented by 15 spp. of Diatomae, 9 spp. of Cyanophyta, 5 spp. of Chlorophyta and Oedogoniales. The most abundant animals are: Lepadella patella and Hypsibius chilensis. The dominant plants are: Diatomae (Navicula seminulum, Pinnularia gibba var. parva) and Cyanophyta (Phormidium glacieae longiarticulata). Cosmopolitan forms are prevalent in the fauna and flora of the oasis. Endemic forms were: Chlorophyta (Chlorosphaera antarctica) and Cyanophyta (P. glacieae longiarticulata, Schizothrix antarctica). On the whole, endemics constitute 9.7% of all species and 26.3% of total floral density. The number of endemic species in other oases of Enderby Land is of a similar order. In all probability, the greatest role in the settlement process is played by the movement of living organisms (or their sporophyte forms) into Antarctic oases by birds or through air currents.—Copyright 1974, Biological Abstracts, Inc.

W78-03830

THE CHEMICAL COMPOSITION OF CENTRAL AMAZONIAN AQUATIC MACROPHYTES WITH SPECIAL REFERENCE TO THEIR ROLE IN THE ECOSYSTEM, Max-Planck-Inst. fuer Limnologie zu Plön (West Germany).

C. Howard-Williams, and W. J. Junk.

Archiv für Hydrobiologie, Vol 79, No 4, p 446-464, 1977. 3 fig, 7 tab, 46 ref, 1 append.

Descriptors: *Aquatic plants, *Amazon River(Brazil), Potassium, Calcium, Sodium, Magnesium, Nitrogen, Phosphorus, Silicon, Ash, Macrophytes.

Levels of ash, sodium, potassium, calcium, magnesium, silicon, nitrogen, phosphorus, calories and cell wall material were determined in 27 species of aquatic plants from the Central Amazon. Replicates of the ten commonest species were collected from the most widely differing habitats. Of the remaining species only a couple of samples were analysed. Aquatic macrophytes had particularly high levels of phosphorus and potassium compared with levels in the soils and waters of the region. Compared with macrophytes from elsewhere, calcium was extremely low in the Amazon material. Floating species had significantly greater ash, magnesium and calcium values

than the rooted species but lower dry matter and cell wall content. Levels of all the nutrient elements correlated negatively with cell wall values. It is suggested that aquatic plants of the area act as nutrient reservoirs in the water bodies, particularly the varzea lakes, and that they play a major role in the biogeochemical cycling in the aquatic ecosystems of the varzea. They also have potential for use as green manures or as livestock fodder because of relatively high nutrient concentrations compared with soils and terrestrial vegetation. (Coyle-Wisconsin) W78-03831

LIMNOLOGICAL STUDIES IN A LARGE, DEEP OLIGOTROPHIC LAKE (LAKE OHRID, YUGOSLAVIA). A SUMMARY OF NUTRITIONAL RADIOBIOASSAY RESPONSES OF THE PELAGIC PHYTOPLANKTON, Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.

H. L. Allen, and B. T. Ocevski.

Hydrobiologia, Vol 53, No 1, p 49-54, 1977. 4 fig, 15 ref. NSF GB-35374.

Descriptors: *Primary productivity, *Phytoplankton, *Lake Ohrid(Yugoslavia), *Bioassay, *Plant growth stimulation, *Oligotrophy, Pelagic phytoplankton, Plant growth, Photosynthesis, Glucose, Acetate, Inorganic phosphorus, Eutrophication.

In a study of nutritional factors that have controlling or regulating influence on pelagic phytoplankton primary productivity rates in Lake Ohrid, Yugoslavia, more than 140 bioassays were conducted throughout the pelagic water column minimally to a depth of 100 m, and frequently to 150 m. Bioassay measurements showed strong depth of 100 m, and frequently to 150 m. Bioassay measurements showed strong stimulation to phytoplankton photosynthesis rates during most seasons in epiplanktonic waters following microadditions of inorganic silica and iron. Photosynthetic stimulation was additive for individual elements and synergistic when simultaneous additions were made. Addition of nitrilotriacetic acid stimulated photosynthetic rates, frequently at a depth of 150 m, considerably below the optimal intensity of photosynthetic light. Inorganic phosphorus was more stimulatory than nitrogen. However, its stimulation was restricted primarily to the periods of spring and summer production. Glucose, acetate, glycine, gibberellic and indoleacetic acids also produced positive responses. B12 was the only vitamin creating a response. Results of these bioassay measurements indicate that the pelagic phytoplankton productivity in Lake Ohrid is nutritionally severely restricted due to: (1) the specific seasonal and annual thermal stratification and light penetration characteristics, and (2) the availability of chelating agents as well as the availability of inorganic iron, silica, phosphorus, and possible vitamins. (Harris-Wisconsin) W78-03833

DISSOLVED ORGANIC MATTER IN LAKE-WATER: CHARACTERISTICS OF MOLECULAR WEIGHT SIZE-FRACTIONS AND ECOLOGICAL IMPLICATIONS, Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.

H. L. Allen.

Oikos, Vol 27, No 1, p 64-70, 1976. 2 fig, 2 tab, 31 ref. NSF 35374.

Descriptors: *Dissolved organic matter, *Molecular structure, *Decomposing organic matter, *Photosynthesis, *Star Lake(VT), *Nutrients, Lakes, Eutrophication, Weight, Lability, Sampling, On-site data collections.

Water samples were collected from Star Lake, Vermont to determine: (1) molecular weight size-fractions present; (2) their lability following exposure to high-intensity ultraviolet (UV) light, and

their chelation-complexation capacity for inorganic iron; (3) bacterial chemo-organotrophic utilization of glucose and changes in dissolved organic carbon molecular weight size-fractions following bacterial release of extra cellular products. Results of fractioning 11 surface samples over a four month period show that the mean dissolved organic carbon concentrations were highest (2.79+ or-1.80 and 2.49+ or-1.01 mg C per liter) in largest (greater than 100,000) and smallest (less than 500) molecular weight fractions, with minimum carbon concentrations present in fraction with molecular weight between 10,000 and 2000. High molecular weight fractions (greater than 50,000) and low molecular weight fractions (less than 500) were labile (about 50% decomposed in 4 hours) and showed increased chelation-complexation capacity for inorganic iron following exposure to the UV light. Intermediate fractions (50,000-2000) were refractory following UV exposure. Bacterial C14-labelled extracellular products decomposed at different rates in comparison with C12 organic compounds in individual weight fractions following UV light exposure, suggesting qualitative differences among the molecular weight fractions. (Harris-Wisconsin) W78-03833

RECENT SEDIMENTATION AND RESUSPENSION OF ORGANIC MATTER IN EUTROPHIC LAKE ESROM, DENMARK, Copenhagen Univ. (Denmark). Freshwater Biological Lab.

E. Lastein.

Oikos, Vol 27, No 1, p 44-49, 1976. 4 fig, 2 tab, 22 ref.

Descriptors: *Sedimentation, *Sedimentation rates, *Organic matter, *Lake Esrom(Denmark), Suspended solids, *Phytoplankton, Eutrophication, Seasonal, Lakes, Primary productivity.

A study was made to relate phytoplankton production to the rates of sedimentation and resuspension in eutrophic Lake Esrom, Denmark. Both primary phytoplankton production and sedimentation show very low values in winter. While the maximal phytoplankton production occurs in April and August-September, maximal sedimentation occurs in April-May after spring bloom and in October following the autumn overturn. Primary phytoplankton production was 460 g sq m per year. If 70% of the organic matter thus produced is consumed through respiration and mineralization of the water column, 140 g of organic matter is left for sedimentation. Organic matter is produced under the surface of the whole lake. However, it is probably sedimented only in the profundal area, which amounts to one half of the total lake surface. Therefore 280 g sq m per year of organic matter should be available for sedimentation. This value is in agreement with the measured sedimentation of 215 g sq m per year of organic matter. Resuspension contributed 155 g sq m per year of dry matter to the dry weight total of 635 g sq m sedimented annually in Lake Esrom. (Harris-Wisconsin) W78-03834

INFLUENCE OF LOW TEMPERATURES ON THE SURVIVABILITY OF SELECTED SPECIES OF ALGAE,

Instytut Zootechniki, Zator (Poland).

M. Nowak, and T. Bednarz.

Acta Hydrobiologica, Vol 18, No 4, p 331-343, 1976. 2 fig, 8 tab, 15 ref.

Descriptors: *Algae, *Temperature, *Cold resistance, *Freezing, Research materials handling, *Basic data collections, *Chlorophyta, *Cyanophyta, Poland, Storage, Survival, *Senedesmus acutus*, *Senedesmus quadricauda*, *Anabaena variabilis*, *Chlorella pyrenoidosa*, *Hordeum flaccidum*, *Stichococcus*, Sampling, Quality control.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Eight green and blue-green algae were exposed to temperatures ranging from -6 to -196°C in various preservatives to determine methods of maintaining the vitality of algae stored in collections. Deep freezing in liquid nitrogen at -196°C is advised for long-term storage of the Polish freshwater chlorophytes *Senedesmus acutus* and *S. quadricauda*, and the freshwater cyanophytes *Anabaena variabilis*, using 5% and 10% aqueous solutions of glycerol as preservatives. Almost unlimited storage can be achieved by this method. For other Polish freshwater chlorophytes—*Chlorella pyrenoidosa*, *Hormidium flaccidum*, and *Stichococcus* sp—the best method is freezing at -6 to -8°C with a 1% glucose solution as preservative, which permits storage up to 33 months. Two halophilous cyanophytes of foreign origin, *Oscillatoria* sp and *Spirulina platensis*, did not survive freezing at -6 to -8°C. Only *C. pyrenoidosa* and *S. acutus* were tested at -18 and -72°C, and after 30 days attempts to revive them were unsuccessful. All algae subjected to freezing were cultured under optimal conditions, then centrifuged, washed with preservatives, suspended in fresh medium, incubated at room temperature for one hour, and transferred into Durham tubes. Samples were placed in a freezer to obtain -6 to -8°C, in a vacuum flask with dry ice plus ethanol of -72°C, and in a vacuum flask with liquid nitrogen for -196°C. (Lynch-Wisconsin) W78-03835

EVALUATION BY BIOASSAYS OF THE TOXICITY TO FISH OF SUGAR FACTORY AFFLUENTS,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology-Entomology.
H. S. Gill, and H. S. Toor.
Acta Hydrobiologica, Vol. 18, No. 4, p 323-329, 1976. 2 tab, 12 ref.

Descriptors: *Toxicity, *Fish, *Lethal limit, *Sugar industry effluents, *Bioassay, Carp, Water pollution effects, Industrial wastes, India, Probit analysis, Jagatjit Sugar Factory (Phagwara Punjab India), Water pollution control.

Carp (*Cyprinus carpio*) exposed to effluents from the Jagatjit Sugar Factory, Phagwara, Punjab, India showed high mortality at all concentrations from 48-100%. Fish measuring 5.8-8.0 cm were tested in waste concentrations of 48%, 60%, 72%, and 100%, plus a control. Mortality was recorded at 24, 48, 72, and 96 hours to calculate the Median Tolerance Level (TL_m) and the safe effluent concentration. Six fish were tested in each concentration. No mortality occurred in the control after 96 hours. In 48% waste concentration, there was 33.3% mortality in 24 hours, and 100% by 96 hours. In 60% concentration, 50% mortality was observed in 24 hours, and 100% in 72 hours. In 72% concentration, 66.7% died in 24 hours, and 100% in 72 hours. In 100% effluent, 50% died within 30 minutes and the rest within two hours. The pH value decreased from 7.85 in the control to 6.45 in 100% effluent. Using probit analysis, TL_m values were estimated at 56.23% for 24 hours, and 49.45% for 48 hours. The safe concentration is established at 11.58% and effluents should be diluted below this level to eliminate directly harmful effects. Injury to the fish by the pollutants was due mainly to respiratory and circulatory failure through obstruction of gills with organic matter, and toxic action after absorption through gills, mouth lining, or gastro-intestinal tract. (Lynch-Wisconsin) W78-03836

THE EFFECT OF ANAEROBOSIS ON HETEROTROPHIC CULTURES OF THE ALGA CHLORELLA PYRENOIDOSA,
Instytut Zootechniki, Zator (Poland).
Z. Sikora.
Acta Hydrobiologica, Vol. 18, No. 4, p 345-352, 1976. 8 fig, 11 ref.

Descriptors: *Algae, *Anaerobic conditions, *Growth rates, *Light intensity, *Chlorella pyrenoidosa, *Chlorophyta, Plant growth, Growth stages, Respiration, Mitochondria, Organelles, Glucose, Photoassimilation, Eutrophication.

A study of the effects of anaerobic conditions on the green alga *Chlorella pyrenoidosa*, grown on glucose in the photoassimilation of glucose phase in low light and in darkness, showed that in the presence of light the lack of oxygen does not limit growth nor affect cell organelle structure. In darkness, the lack of oxygen inhibits growth and results in destruction of cell organelles, especially of mitochondria, due to inhibition of cell respiration. Cultures of *Chlorella pyrenoidosa* were grown in test tubes on 5 ml of MM medium with 1% glucose, at a pH of 7.2 and a temperature of 27°C. In experiments with light, intensity was 400 Lux. Three cultures were tested: (1) 25-cm test tubes plugged with cotton wool with normal air access and a volume of 20 sq cm over the culture; (2) small test tubes plugged with cotton wool with poor air access and a volume of 0.7 sq cm over the culture; and (3) small test tubes entirely filled with the medium, stopped with a cork and sealed with wax, with no air access. The number of cells was monitored at 48, 72, and 144 hours of culture. In light an almost identical growth was found in all cases, except that as the access of oxygen was limited, the length of the growth phase increased. In darkness, as air access became more limited, growth was increasingly inhibited, and the lengthening of growth phase lag was even more pronounced. (Lynch-Wisconsin) W78-03837

THE PROFUNDAL BENTHIC ENVIRONMENT OF TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO.

J. F. LaBounty, and J. J. Sartoris.
In: Studies of the Benthic Environment of Twin Lakes, Colorado, October 1976. p 1-28, 20 fig, 6 tab, 40 ref. REC-ERC-76-12.

Descriptors: *Distribution, *Benthic fauna, *Oligotrophy, *Larvae, *Twin Lakes(CO), Colorado, Lakes, Benthos, Limnology, Clams, Shrimp, Heavy metals, Anaerobic conditions, Trophic levels, Seasonal, Spatial distribution, Temporal distribution.

The first paper of a three-part study of the benthos of Twin Lakes, CO, focuses on composition, physical distribution, and seasonal distribution of benthic fauna, with a discussion of the growth of individual larvae. Twin Lakes is a pair of Rocky Mountain glacial lakes on Lake Creek, an Arkansas River tributary, in Lake County. The lakes are classified as relatively oligotrophic, second-class dimictic lakes, although the benthic fauna is more characteristic of mesotrophic lakes. The water temperature range is 0-20°C; the lakes freeze over from December to May. Benthic samples were collected from both lakes during June 1974-April 1975. The ubiquitous mysis shrimp (*Mysis relicta*) was found on and within the bottom environment. Few benthic macrofauna were found, but were much more abundant in the lower lake than the upper lake, even though there is little limnological difference between the lakes. The upper lake presently has the most sparse benthic fauna of any lake reported, while the lower lake is about average. Mollusks included fingernail clams (*Pisidium casertanum* and *P. pauperulum*) and Diptera included midge-fly larvae (*Chironomus* sp., *Phaenopsectra* sp., and *Dicrotendipes modestus*). *Chironomus* was the most abundant group, increasing with depth; clams were found almost exclusively in the lower lake. A severe winter usually results in anaerobic bottom conditions and dissolved heavy metals in the upper lake. (See also W77-07806) (Lynch-Wisconsin) W78-03838

AGING AND EVALUATION OF TWIN LAKES SEDIMENTS,
Colorado Cooperative Fishery Unit, Fort Collins. For primary bibliographic entry see Field 2J. W78-03839

BACTERIOLOGICAL SURVEY OF TWIN LAKES, COLORADO,
Bureau of Reclamation, Denver, CO.
W. O. Deason.

In: Studies of the Benthic Environment of Twin Lakes, Colorado, October 1976. p 41-47, 1 fig, 4 tab, 19 ref. REC-ERC-76-12.

Descriptors: *Bacteria, *Coliforms, *Corrosion, *Twin Lake(CO), Lakes, Colorado, Water pollution sources, Recreation, Environmental effects, Pipes, Powerplants, Bioindicators.

Sampling of water for bacterial content at six stations in Twin Lakes, Colorado, indicated that the two lakes currently have low total fecal coliform densities. Samples were obtained during June-September 1975, prior to the opening of the Mt. Elbert Pumped-Storage Powerplant. Bottom samples from four permanent stations show that bottom muds are relatively free of coliform bacteria (less than 100 per gram), but contain high concentrations of iron bacteria (40-2400 MPN/g) and detectable amounts of sulfur bacteria. It is concluded that pipe corrosion could occur where buried pipe would be wet most of the time and anaerobic conditions exist. Large, high-velocity pipes highly aerobic water may not be affected unless stagnant areas develop near pipe walls and seams. Twin Lakes, a pair of glacial lakes in the Rocky Mountains, is a popular recreation area and thus susceptible to bacterial water pollution. Samples taken on the upper lake yielded higher total coliform counts (mean 3.1-6.4 than the lower lake; the highest counts on the upper lake (10-25) were recorded during September, probably due to higher air temperatures and increased visitor use. (See also W77-07806) (Lynch-Wisconsin) W78-03840

CONCENTRATION OF TOTAL THIAMINE IN ORGANS AND TISSUES OF FISHES FROM THE KREMENCHUG RESERVOIR, (IN RUSSIAN),
Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
O. M. Arsan, and A. Ya. Malyarevskaya. Gidrobiol Zh. 10(6), p 91-93, 1974.

Descriptors: *Cyanophyta, *Eutrophication, Water pollution effects, Algae, Bream, Fish, Intestine, *Kremenchug Reservoir(USSR), Liver, Loach, Muscle, Perch, Reservoirs, Rudd, *Thiamine(Fish).

The content of total thiamine in the liver, intestine and muscles of perch, rudd, loach and bream from the Kremenchug Reservoir on the Dnieper River (USSR) was determined in late June-early July and late Sept.-early Oct., i.e., when an intense bloom of blue-green algae was present and absent, respectively. The content of total thiamine in fishes caught from the reservoir was related to the algal bloom. The season also affects its content in the liver, intestine and muscles of the fishes. Copyright 1975, Biological Abstract, Inc. W78-03862

WASTE DISPERSION CHARACTERISTICS AND EFFECTS IN AN OCEANIC ENVIRONMENT,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Engineering Dept.

L. L. Falk, T. D. Myers, and R. V. Thomann. Available from the National Technical Information Service, Springfield, VA 22161 as PB-268 157. Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Agency Cincinnati, Ohio, Office of Research and Development Re-

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

port No. EPA-600/2-77-112, June 1977. 318 p, 22 fig, 29 tab, 39 ref. EPA 12020 EAW.

Descriptors: *Waste disposal, *Dispersion, *Water pollution effects, Environmental effects, Mathematical models, Benthos, *Outer Continental Shelf, *Echinorachnius parma*.

Operation of a waste disposal system for oceanic dispersion offered an opportunity to develop a mathematical model of dispersion behind a moving barge. The model takes into account the vertical temperature-density structure of the ocean, and the density and settling characteristics of the wastes. It was verified with several sets of field data obtained behind the barge. Results show, and the model reproduces, that the wastes do not reach the ocean bottom when a thermocline is present. They are distributed from top to bottom (140 ft) when the ocean is isothermal. Studies on marine life of the disposal area showed no changes definitely attributable to the disposal operation. Additional information is needed to establish whether a seasonal fluctuation of dead sand dollars, *Echinorachnius parma*, a benthic organism, is a natural phenomenon or can be attributed to wastes reaching the bottom. Cost data on the barging operation are given. (Sinha -OEIS) W78-03874

DREDGE DISPOSAL STUDY. SAN FRANCISCO BAY AND ESTUARY. MAIN REPORT.

Army Engineer District, San Francisco. For primary bibliographic entry see Field 5E. W78-03875

FLOW AND MAIN ELEMENTS OF BALANCE OF BIOGENIC SUBSTANCES AND MAIN IONS IN THE KIEV RESERVOIR, (IN RUSSIAN), Akademiya Nauk USRS, Kiev. Inst. Hidrobiologii. A. I. Denisova. Gidrobiol Zh. 10(6), p 5-12, 1974.

Descriptors: *Iron, Sedimentation, Rivers, *Silicon, *Phosphorus, Water pollution effects, *Biogenic elements, *Eutrophication, Flow, *Ions, *Kiev, Reservoir(USSR), Ukrainian-SSR.

Calculation of the inflow of biogenic substances and main ions of the Kiev (Ukrainian SSR, USSR) water storage basin and outflow into the after bay showed that the sedimentation of Fe brought into the storage basin with surface outflow and its accumulation take place at the expense of inter-basin processes. Silicon and P are also accumulated. For the last 15 yr the content of mineral N has increased showing that these rivers have become eutrophic—Copyright 1975, Biological Abstracts, Inc. W78-03878

MARINE STUDIES OF SAN PEDRO, CALIFORNIA. PART II. POTENTIAL EFFECTS OF DREDGING ON THE BIOTA OF OUTER LOS ANGELES HARBOR. TOXICITY, BIOASSAY AND RECOLONIZATION STUDIES.

University of Southern California, Los Angeles. Allan Hancock Foundation; and University of Southern California, Los Angeles. Inst. of Marine and Coastal Studies.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 858. Price codes: A15 in paper copy, A01 in microfiche. June 1976. 330 p, 4 append. Soule, D.F. and Oguri, M. (Eds.).

Descriptors: *Baseline studies, *Water pollution effects, *Pollutant identification, *Dredging, California, Harbors, Heavy metals, Resources development, Environmental effects, *Los Angeles Harbor(Calif.).

This volume contains the following studies: Potential ecological effects of hydraulic dredging in Los

Angeles Harbor: An overview; Resuspended sediment elutriate studies on the northern anchovy; Effects of Los Angeles Harbor sediment elutriate on the California killifish, *Fundulus parvipinnis* and white croaker, *Genyonemus lineatus*; Toxicity and heavy metals in three species of crustacea from Los Angeles Harbor sediments; Bioassay and heavy metal uptake investigations of resuspended sediment on two species of polychaetous annelids; Biomass and recolonization studies in the outer Los Angeles Harbor; and Water quality evaluation of dredged material disposal from Los Angeles Harbor. There is also data appended as: Computer mapping of pollutants in Los Angeles Harbor; Concentrations of trace elements and chlorinated hydrocarbons in marine fish; Concentrations of trace metals in marine organisms; and Primary productivity, chlorophyll a, and assimilation ratios in Los Angeles—Long Beach Harbor, 1973 and 1974. (See also W78-03883 thru W78-03889) (Sinha-OEIS) W78-03882

POTENTIAL BIOLOGICAL EFFECTS OF HYDRAULIC DREDGING IN LOS ANGELES HARBOR: AN OVERVIEW,

University of Southern California, Los Angeles. D. F. Soule, and M. Oguri. In: 'Marine Studies of San Pedro Bay, California, Part II', June 1976. p 1-14, 2 fig, 17 ref.

Descriptors: *Dredging, *Water pollution effects, *Sediments, Baseline studies, Resources development, California, Biological effects, Los Angeles Harbor.

In Los Angeles Harbor, the main channel borders the Palos Verdes Hills at the western edge of the estuarine Los Angeles River depositional area, which is part of San Pedro Bay. Areas of the bay sheltered behind the federal breakwater are divided politically into the Port of Los Angeles on the west, The Port of Long Beach in the center along with the U.S. Navy facility, and a City of Long Beach Harbor area lying to the east. Harbor channels were dredged to 35 feet a number of years ago, but subsidence due to pumping of the underlying oil fields caused parts of the Long Beach main channel and Cerritos Channel to sink about 60 foot depths. Both ports now require increased channel depths, as well as additional areas capable of handling containerized cargo, and gas and oil tankage or pumping facilities, but the Port of Los Angeles is especially handicapped by its shallow channels. The original estuarine channels and the flood plains draining the Los Angeles basin have long since been channelized, filled or blocked by development, so that recreating a natural estuary would be virtually impossible in the heavily urbanized area. (See also W78-03882) (Sinha-OEIS) W78-03883

RESUSPENDED SEDIMENT ELUTRIATE STUDIES ON THE NORTHERN ANCHOVY,

University of Southern California, Los Angeles. Allan Hancock Foundation. For primary bibliographic entry see Field 5A. W78-03884

EFFECTS OF LOS ANGELES HARBOR SEDIMENT ELUTRIATE ON THE CALIFORNIA KILLIFISH, *FUNDULUS PARVIPINNIS* AND WHITE CROAKER, *GENYONEMUS LINEATUS*,

University of Southern California, Los Angeles. Allan Hancock Foundation. D. W. Chamberlain.

In: 'Marine Studies of San Pedro Bay, California, Part II', June 1976. p 33-48, 5 fig, 1 tab, 8 ref.

Descriptors: *Toxicity, *Water pollution effects, Sediments, Dredging, Biological effects, **Fundulus parvipinnis*, **Genyonemus lineatus*.

California killifish, *Fundulus parvipinnis*, were held in 5-gallon aquaria for a period of 96 hours to test toxic effects of elutriate from sediments from three stations. One fish died during the 96 hours. Ten fish died in the subsequent 22 days of observation. Dissolved oxygen, pH, specific gravity, temperature and nitrite-nitrogen parameters in the water were monitored periodically. Fish were not fed during the experiment. Deaths were probably related to lack of food rather than to the presence of any toxic substances in the elutriate. The white croaker, *Genyonemus lineatus*, showed no toxic effects in 96-hour elutriate tests from one station. Deaths in the 28-day tests seemed attributable to primary or secondary effects of starvation. Tissue analysis after the 14-day exposure to elutriate indicated increases of 1.5-2 times over control fish levels of eight trace metals. (See also W78-03882) (Sinha-OEIS) W78-03885

TOXICITY AND HEAVY METALS UPTAKE IN THREE SPECIES OF CRUSTACEA FROM LOS ANGELES HARBOR SEDIMENTS,

University of Southern California, Los Angeles. Allan Hancock Foundation. J. R. McConaughay.

In: 'Marine Studies of San Pedro Bay, California, Part II', June 1976. p 49-67, 1 fig, 8 tab, 24 ref.

Descriptors: *Toxicity, *Heavy metals, *Water pollution effects, *Dredging, Sediment, *Crustaceans, California, Los Angeles Harbor, *Acartia tonsa*, *Tisbe* sp. *Pachygrapsus* crassipes.

Two species of crustaceans, *Acartia tonsa* and *Tisbe* sp., were subjected to the filtrate fraction of resuspended sediments from 12 stations in the Los Angeles Harbor. The 96 hour bioassays for *A. tonsa* produced significant reductions in the survival rates of test groups at stations LNG-6, LNG-7, 16, 17, 18, 24, and 27. In the *Tisbe* bioassays only station LNG-7 had significantly lower survival in the test group than in controls, while test group survival at stations LNG-4, -23 and -27 were significantly higher than control survival. This data suggests that dredging operations could have an adverse effect on the *A. tonsa* population and consequently an effect on the plankton composition and food chain in the Los Angeles Harbor. However, the stations with poorest quality are in the area to be filled. Additional experiments were conducted to determine if the lined shore crab, *Pachygrapsus* crassipes, was capable of accumulating heavy metals from resuspended sediments. Following a 7 day exposure to the sediment elutriate the gill tissue was examined for 9 heavy metals. Because of extreme variations in the data no discernible trends were observed. (See also W78-03882) (Sinha-OEIS) W78-03886

BIOASSAY AND HEAVY METAL UPTAKE INVESTIGATIONS OF RESUSPENDED SEDIMENT ON TWO SPECIES OF POLYCHAETOUS ANNELIDS,

University of Southern California, Los Angeles. Allan Hancock Foundation. R. R. Emerson.

In: 'Marine Studies of San Pedro Bay, California, Part II', June 1976. p. 69-90, 1 fig, 10 tab, 16 ref.

Descriptors: *Bioassay, *Heavy metals, *Toxicity, *Water pollution effects, Sediments, Dredging, California, Los Angeles Harbor, Biological effects, Polychaetous annelids, *Capitella capitata*, *Ophryotrocha* sp.

Two species of polychaetous annelids (*Capitella capitata* and *Ophryotrocha* sp.) were used in a series of bioassays to determine the toxicity of resuspended sediments from fourteen stations in Los Angeles Harbor. Significant mortality did not occur in either short-term (96-hour) or long-term (28-day) bioassays using *Ophryotrocha* sp. Numbers of offspring were significantly reduced in all

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Group 5C—Effects Of Pollution

sediments except the outermost harbor station (LNG-1), indicating sublethal effects. Development success of *Capitella capitata* larvae ranged from 40% to 95%. The more grossly contaminated sediments yielded lower numbers of successfully developing larvae but higher growth rates in the surviving larvae. Contamination levels of the sediments correlated more closely with sediment particle size than with distance from the outside harbor. Heavy metal concentrations in the tissues of *Capitella capitata* did not correspond with sediment contamination levels. Resuspended sediment may result in "scavenging" which lowers the concentration of some heavy metals in the seawater. (See also W78-03882) (Sinha-OEIS) W78-03887

BIO MASS AND RECOLONIZATION STUDIES IN THE OUTER LOS ANGELES HARBOR, University of Southern California, Los Angeles. Allan Hancock Foundation.

D. F. Soule.
In: "Marine Studies of San Pedro Bay, California, Part II", June 1976, p 91-153, 13 fig, 28 tab.

Descriptors: *Biomass, *Benthos, *Water pollution effects, *Baseline studies, Dredging, Outfall sewers, California, Los Angeles Harbor, Recolonization.

Benthic biomass sampling in areas of proposed dredging of a new ship channel and adjacent underwater landfill showed a zone near the shoreline and waste outfalls of low biomass and outer areas of higher standing stock. These data were compared with five years of monthly water column biomass sampling with settling racks. Recolonization studies were carried out using jars supplied with newly exposed sediments or existing site sediments. Few significant differences were found between the two types of sediments, but spatial and seasonal differences in species and biomass were observed. The dominant species in recolonizing were less prominent in mature communities at the sites. However, most species that dominate mature communities were present as early as within the six week exposure periods. (See also W78-03882) (Sinha-OEIS) W78-03888

WATER QUALITY EVALUATION OF DREDGED MATERIAL DISPOSAL FROM LOS ANGELES HARBOR, University of Southern California, Los Angeles. Environmental Engineering Program.

K. Y. Chen, and C. C. Wang.
In: "Marine Studies of San Pedro Bay, California, Part II", June 1976, p 155-236, 16 fig, 34 tab, 24 ref.

Descriptors: *Water quality, *Water pollution effects, *Dredging, Waste disposal, Heavy metals, California, Los Angeles Harbor, Chlorinated hydrocarbons.

This study was initiated in December 1973 with special emphasis on the physico-chemical characterization of sediments from the Los Angeles Harbor area, and the evaluation of potential water quality degradation resulting from the disposal of dredged and fill material. The short-term and long-term effects on water quality were investigated in conjunction with several treatment procedures. (See also W78-03882) (Sinha-OEIS) W78-03889

EFFECT OF SUBLETHAL METAL POLLUTANTS ON THE FIDDLER CRAB *UCA PUGILATOR*, South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.

W. B. Vernberg, and P. J. DeCoursey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-267-940. Price codes: A04 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-77-024, Feb. 1977, 57 p, 25 ref, 44 fig, 6 tab.

Descriptors: *Larval growth stage, *Cadmium, *Mercury, *Temperature, *Salinity, *Shellfish, *Crabs, *Absorption, *Metabolism, Animal behavior, Environmental effects, Enzymes, Crustaceans, Invertebrates, Metals, Laboratory studies, Bioassay, Stress, Growth stages, Biochemistry, Animal physiology, Water pollution effects, *Sublethal effects, Synergistic effects, Bioaccumulation.

Studies have been carried out on the synergistic effects of sublethal concentrations of mercury (Hg) and/or cadmium (Cd) in conjunction with temperature and salinity stress on larval and adult fiddler crabs, *Uca pugilator*. Six biological parameters of the adult organism were monitored including survival, tissue uptake, metabolism, behavior, microscopic anatomy, and enzymatic activity, using metal concentrations of 0.18 ppm Hg and 1.0 ppm Cd. Studies with larval stages (zoal stages I, III, V and megalops) considered survival, metabolism and behavior under conditions of 1.8 ppm Hg and 1.0 ppm Cd. The effect of mercury or cadmium on *Uca pugilator* depends upon a number of factors, including stage of the life cycle, sex, thermal history, and environmental conditions. Data presented here suggest that the mode of action of the two metals is not the same. (Katz) W78-03919

EFFECTS OF HYDROGEN SULFIDE ON FISH AND INVERTEBRATES PART I—ACUTE AND CHRONIC TOXICITY STUDIES, Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries, and Wildlife.

L. L. Smith, Jr., D. M. Oseid, I. R. Adelman, and S. J. Broderius.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-256-410. Price codes: A14 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-76-024, 286 p, 1977, 8 fig, 136 tab, 39 ref.

Descriptors: *Toxicity, *Sulfides, *Hydrogen sulfide, *Freshwater fish, *Invertebrates, Path of pollutants, Suckers, Brook trout, Rainbow trout, Salmonids, Lethal limit, Mortality, Growth stages, Bioassay, Resistance, Growth rates, Temperature, Fish reproduction, Fish physiology, Fish behavior, *Environmental effects, Methodology, Seasonal, *Bioaccumulation, *Fathead minnows, Goldfish, Bluegill, Walleye, White sucker, Asellus, Crangonyx, Gammarus, Baetis, Hexagenia, Ephemera, Procambarus, Cambarus.

Acute and chronic toxicity of hydrogen sulfide to seven fish species and eight invertebrates were determined in continuous-flow bioassays. In 159 acute tests lethal threshold concentration for juvenile fish varied from 0.0087 mg/liter in rainbow trout to 0.0840 mg/liter in goldfish. Except in goldfish, the fry stage was up to three times more sensitive than the juvenile. For invertebrates the 96-hr LC50 ranged from 0.020 mg/liter in *Baetis* to 1.070 mg/liter in *Asellus*. Acute toxicity of H2S to fathead minnows varied 24-fold between 6.5 and 24.0C. Temperature effects were not as marked on invertebrates. In chronic exposure to H2S, maximum no-effect concentration to fish ranged from 0.0004 mg/liter in bluegills to 0.0100 mg/liter in goldfish. No-effect level was determined from growth, survival, reproduction, or swimming performance. Maximum safe levels ranged from 0.0012 mg/liter in *Gammarus* to 0.0152 mg/liter in *Hexagenia*. (See also W77-04552) (Klein) W78-03920

ACUTE AND CHRONIC TOXICITY OF CHLORDANE TO FISH AND INVERTEBRATES, Chemico Process Plants Co., El Monte, CA. Envirogenics Systems.

R. D. Cardwell, D. G. Foreman, T. R. Payne, and D. J. Wilbur.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-267-544. Price codes: A07 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-77-019, February 1977, 125 p, 50 tab, 1 fig, 99 ref.

Descriptors: *Bioassays, Laboratory tests, *Freshwater fish, Sunfish, *Brook trout, *Daphnia, Crustaceans, Zooplankton, *Aquatic insects, Mortality, *Chlorinated hydrocarbon pesticides, Insecticides, Amphipoda, Growth, Reproduction, *Bluegill, sunfish, Lepomis, *Fathead minnow, Pimephales, Salvelinus, *Daphnia magna*, *Hyalella, Midges, Chironomus, Flow through bioassays, Whole body residues, *Chronic effects.

The acute and chronic toxicity of technical chlordane to bluegill, fathead minnow, brook trout, *Daphnia*, *Hyalella*, and *Chironomus* No. 51 were determined with flow-through conditions. The purpose was to estimate concentrations producing acute mortality and those having no effect on the long-term survival, growth, and reproduction of the various species. Whole body residues of technical chlordane components were measured in the three invertebrate species at the end of the chronic exposure tests. Concentrations of technical chlordane causing 50% mortality in 96 hr were 36.9 micrograms/l for fathead minnow, 47 micrograms/l for brook trout, and 59 micrograms/l for bluegill, while that causing 50% immobilization in the cladoceran, *D. magna*, was 28.4 microgram/l. The amphipod, *H. azteca*, was only slightly affected at 96 hr by the chlordane concentrations tested, and the 168 hr EC50 was 97.1 micrograms/l. Acute mortality of midges, *Chironomus* No. 51, was not successfully evaluated. With respect to the test conditions employed and life cycle stages evaluated, the lowest concentrations of technical chlordane found to cause major chronic effects were 0.32 micrograms/l for brook trout, 1.22 micrograms/l for bluegill, 1.7 micrograms/l for midges, 11.5 micrograms/l for amphipods, and 21.6 micrograms/l for cladocerans. (Katz) W78-03921

EFFECTS OF POLLUTANTS ON SUBMARINE PLANT SYNECOLOGY, Western Washington State Coll., Bellingham.

M. A. Dube.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266-675. Price codes: A04 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-77-020, February 1977, 44 p, 7 tab, 10 fig.

Descriptors: Water quality, Biomass, *Aquatic plants, Ecology, Marine algae, *Marine plants, *Industrial wastes, *Mineral industry, *Oil wastes, Plant groupings, Kelps, Water pollution effects, Methodology, Environmental effects, *Washington, Standing crops, Sedimentation, Cherry Point, Puget Sound, Nooksack River, *Oil refinery, *Aluminum reduction plant, Bull kelp, *Nereocystis*, Respiration rate.

SynecoLOGY of marine plant communities has been studied in Northern Puget Sound. Major sources of pollutants include the Nooksack River, an oil refinery and an alumina reduction plant. A method of analysis involving comparisons of standing crops of species within the communities, standing crop of groups of morphologically similar species, and standing crop of entire communities is described. Stable species of the community are distinguished as well as those which appear to be indicators of environmental change. The floating bull kelp, *Nereocystis leutkeana*, is shown to have a depressing effect of standing crop and on the presence of other elements of the community. An increased respiration rate in kelps exposed to aluminum plant effluent was measured. Physical factors of the environment were measured. Poorer conditions for growth of algae in the environs of the aluminum company following its expansion are indicated by the accumulation of silt, the decrease

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in standing crop, and a loss of certain species. (Katz)
W78-03922

BEHAVIOR OF MERCURY, CHROMIUM, AND CADMIUM IN AQUATIC SYSTEMS.
Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W78-03923

EFFECTS OF COPPER AND ZINC ON SMOLIFICATION OF COHO SALMON,
Oregon Dept. of Fish and Wildlife, Corvallis.
H. W. Lorz, and B. P. McPherson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-268 304. Price codes: A05 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-032, March 1977. 68 p, 14 tab, 19 fig, 40 ref.

Descriptors: *Copper, *Zinc, *Metals, Water pollution effects, Salmon, Juvenile fish, Fish behavior, Fish physiology, Freshwater, Enzymes, *Fish migration, Bioassay, Methodology, Mortality, Seawater, Fish growth, *Coho salmon, Sublethal levels, *Osmotic control, *Ionic control, ATPase activity.

In this study, exposure of smolt age coho to sublethal levels of copper in freshwater interfered with normal osmotic and ionic control in blood plasma; when the copper exposed fish were transferred to seawater the plasma osmolarity and chloride concentrations increased significantly, compared to controls, and many died. These responses were attributed in part to an observed suppression of Na^+ and K^+ - activated ATPase activity in the gills of copper exposed fish. The most sensitive latent effect of exposure to sublethal levels of copper was the failure of copper exposed coho smolts to migrate successfully following release into a natural stream. All copper concentrations tested (5-30 micrograms/l) produced adverse effects and were well below the 96-hr LC50 (60-74 micrograms/l). Exposure to sublethal levels of zinc produced no similar adverse effects. (Katz)
W78-03924

A CONTROLLED BIOASSAY SYSTEM FOR MEASURING TOXICITY OF HEAVY METALS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
For primary bibliographic entry see Field 5A.
W78-03926

DISSOLVED OXYGEN TEMPERATURE, SURVIVAL OF YOUNG FISH AT FISH SPAWNING SITES,
North Dakota State Univ., Fargo. Dept. of Zoology.
J. J. Peterka, and J. S. Kent.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 139. Price codes: A03 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-76-113, December 1976. 35 p, 15 tab, 8 fig, 6 ref.

Descriptors: Freshwater fish, Fish eggs, Fish reproduction, Fish hatcheries, Fish physiology, *Dissolved oxygen, *Temperature, Water temperature, *Mortality, Bioassay, *Bass, *Sunfishes, *Pikes, On-site-investigations, Fluctuations, Juvenile fish, *Dissolved gases, Northern pike, *Smallmouth bass, Natural habitat, *Dissolved oxygen fluctuations.

Fluctuations of dissolved oxygen concentrations and water temperatures in their natural spawning sites were measured during embryo through larva stages of northern pike (*Esox lucius*), and during embryo and sac larva stages of bluegills (*Lepomis macrochirus*), and pumpkinseeds (*Lepomis gibbosus*). At northern pike sites, dissolved oxygen

concentrations from combined measurements 1 and 10 cm from the bottom ranged from 0.0-16.6 mg/liter, and water temperatures from 2.5-23.0°C; average daily fluctuations were 3.0 mg/liter and 1.6°C. For bluegill and pumpkinseed nests, dissolved oxygen concentrations 1 cm from the bottom ranged from 2.4-18.2 mg/liter and water temperatures from 15.0-27.5°C, with average daily fluctuations of 4.4 mg/liter and 3.3°C. In field experiments to determine acute effects of a single exposure to low dissolved oxygen concentrations, tolerance decreased from embryo to larva stages for northern pike and from embryo to sac larva stages from bluegills and smallmouth bass (*Micropterus dolomieu*). (Katz)
W78-03927

TRANSPORT OF GRANITIC SEDIMENT IN STREAMS AND ITS EFFECTS ON INSECTS AND FISH,
Cooperative Fisheries Research Unit, Moscow.
For primary bibliographic entry see Field 21.
W78-03928

EFFECTS OF FEEDLOT RUNOFF ON FREE-LIVING AQUATIC CILIATED PROTOZOA,
Illinois Univ. at Urbana-Champaign. Dept. of Veterinary Pathology and Hygiene.
For primary bibliographic entry see Field 5B.
W78-03929

HEALTH SIGNIFICANCE OF KLEBSIELLA PNEUMONIAE IN DRINKING WATER EMANATING FROM REDWOOD TANKS,
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 5F.
W78-03933

A STUDY OF THE EFFECTS OF STREAM CHANNELIZATION AND BANK STABILIZATION ON WARMWATER SPORT FISH IN IOWA: SUBPROJECT NO. 3. SOME EFFECTS OF SHORT-REACH CHANNELIZATION ON FISHES AND FISH FOOD ORGANISMS IN CENTRAL IOWA WARMWATER STREAMS,
Iowa Cooperative Fishery Unit, Ames.
L. R. King, and K. D. Carlander.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 078. Price codes: A11 in paper copy, A01 in microfiche. Fish and Wildlife Service, Report FWS/OBS-76-13, April 1976. 217 p, 51 tab, 6 fig, 29 ref.

Descriptors: Iowa, *Streams, Freshwater fish, *Channel improvement, Channel morphology, Channeling, *Channels, Fish populations, Fish food organisms, Fish harvest, Water quality, Dissolved oxygen, Invertebrates, Turbidity, On-site-investigations, *Bridge construction, *Brush shelter, *Unchannelized streams.

There was no evidence that dissolved oxygen, turbidity, or stream macro-invertebrates as measured by core, drift, or artificial substrate samples differed upstream, in the channel, or below. Reduction of brush substrate in the channel and downstream would mean reduction in invertebrate production, however. More fish species were collected by electroshocking in unchannelized than in channelized localities in 5 of the 6 streams and in the 6th the number of species was the same in both localities. In 2 recently channelized streams that lacked cover in the channel, catches of fish were significantly less in the channelized than in the unchannelized localities, but in 3 streams channelized 10 to 15 years where some cover had developed, catches in the channel runs were similar or significantly greater than in unchannelized runs. In the unchannelized locations, however, more of the fish were in brush and total populations were not adequately represented by electroshocking in the runs. The most evident impact of short-reach channelization is the removal

of cover in the altered area and the loss of stream length. (See also W76-12231) (Katz)
W78-03935

STUDIES OF THE ECOLOGICAL IMPACT OF REPETITIVE AERIAL APPLICATIONS OF HERBICIDES ON THE ECOSYSTEM OF TEST AREA C-52A, EGLIN AFB, FLORIDA,
Armament Development and Test Center, Eglin AFB, FL; and Air Force Armament Lab., Eglin AFB, FL.
For primary bibliographic entry see Field 5A.
W78-03937

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS,
Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.

S. S. Lande, J. Santodonato, P. H. Howard, D. Greninger, and D. H. Christopher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 910. Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency, Report EPA 560/2-76-007, August 1976. 192 p, 54 tab, 10 fig, 353 ref.

Descriptors: *Phosphates, *Organophosphorous pesticides, *Toxicity, *Industrial wastes, *Insecticides, Path of pollutants, Environmental effects, Pesticides, Water pollution sources, Water pollution effects, Monitoring, Metabolism, Water quality standards, Haloalkyl phosphates, Mutagens, Carcinogens, Teratogens, Fire retardants, Cholinesterase inhibitors, Naled, Dichlorvos.

This report reviewed the potential environmental hazard from the commercial use of haloalkyl phosphate (HAP). Emphasis was placed mostly on the four tris(haloalkyl) phosphates which are used as fire retardants. Data on the two pesticide HAP's naled and dichlorvos, were used for comparison purposes. The tris-HAP's (1) are produced in significant quantities, (2) have several potential sources of environmental contamination, (3) have an unknown fate in the environment, (4) may act as cholinesterase inhibitors, and (5) are potentially carcinogenic and mutagenic. (Katz)
W78-03938

MARINE DIATOMS GROWN IN CHEMOSTATS UNDER SILICATE OR AMMONIUM LIMITATION. IV. TRANSIENT RESPONSE OF CHAETOCEROS DEBILIS, SKELETONEMA COSTATUM, AND THALASSIOSIRA GRAVIDA TO A SINGLE ADDITION OF THE LIMITING NUTRIENT,
Washington Univ., Seattle. Dept. of Oceanography.
H. L. Conway, and P. J. Harrison.

Marine Biology, Vol. 43, 1977, p 33-43, 7 fig, 8 tab, 15 ref.

Descriptors: *Bioassay, *Phytoplankton, *Diatoms, *Nutrients, Laboratory tests, *Ammonium compounds, Ammonium salts, Plant growth, Algae, *Plant physiology, Plant population, Water quality, Primary productivity, Silicates, Kinetic response, Ammonium limited, Silicate limited, Ammonium starved, Silicate starved, Limiting nutrients, Nutrient starvation, Nutrient depleted.

The kinetic response of ammonium- or silicate-limited and ammonium- or silicate-starved populations of *Chaetoceros debilis*, *Skeletonema costatum*, and *Thalassiosira gravida* was determined by a single addition of the limiting nutrient to a steady-state culture and subsequent monitoring of the nutrient disappearance of the limiting and non-limiting nutrients at frequent time intervals. The kinetic response of non-limited (nutrient) populations of these three species was also determined. Three distinct modes of the uptake of the

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limiting nutrient were observed for ammonium- or silicate-limited populations of these three species, surge uptake (Vs), internally (cellular) controlled uptake (Vi), and externally (ambient limiting nutrient concentration) controlled uptake (Ve). In a number of parameters that were measured, *T. gravida* was clearly different from *C. debilis* and *S. costatum* and its recovery from nutrient starvation was the slowest. Recovery of all species from silicate limitation or starvation was slower than from ammonium limitation or starvation. Ammonium-starved populations maintained a maximal uptake rate at a substrate concentration an order of magnitude lower (0.1 NH4-N) than that observed for NH4-limited populations (1.0 NH4-N). Adaptation to the severity of the nutrient limitation occurred as changes in the magnitude of cellular characteristics, such as short-term uptake potential (Vs) and affinity for the substrate (Ks). (Katz) W78-03940

ON MERCURY AND SELENIUM CONTAINED IN TUNA FISH TISSUES - II. TOTAL MERCURY IN MUSCLES AND VISCERA OF YELLOWFIN TUNA (IN JAPANESE),
Shimonoeki Univ. of Fisheries (Japan).
For primary bibliographic entry see Field 5A.
W78-03941

ON MERCURY AND SELENIUM IN TUNA FISH TISSUES - III. MERCURY DISTRIBUTION IN YELLOWFIN TUNA, (IN JAPANESE),
Shimonoeki Univ. of Fisheries (Japan).
For primary bibliographic entry see Field 5A.
W78-03942

THE TOXIC EFFECTS OF HYDROCARBONS UPON THE NAUPLIAR AND ADULT STAGES OF BALANUS (CRUSTACEA: CIRRIPEDIA),
Hong Kong Univ. Dept. of Zoology.
B. Morton, and R. S. S. Wu.
Marine Pollution Bulletin, Vol. 18, No. 10, p 232-236, 1977. 8 fig, 12 ref.

Descriptors: *Toxicity, *Mortality, *Organic compounds, *Oil spills, *Larval growth stage, *Mature growth stage, *Littoral, *Animal metabolism, Animal physiology, *Morbidity, Growth stages, Laboratory tests, Water pollution effects, Oil, Oil pollution, Crustacean oil, *Barnacles, *Balanus*, *Kerosene, Hydrocarbons, BP 1002.

This study investigated the comparative toxicity of 4 hydrocarbons (i.e. BP 1002, kerosene, 'Bukokleen,' 'Chemkleen') to two species of littoral barnacles. It was found that BP 1002 was the most toxic with a lower and similar toxicity found for Chemkleen and Bukokleen. The toxicity of kerosene is comparatively low. A second experiment using kerosene and BP 1002 studied effects on two growth stages. Both barnacle species had a similar susceptibility, the nauplii being killed at lower concentrations than the adult. (Katz) W78-03943

COPPER SORPTION AND RELEASE BY CYCLOTELLA MENEGHINIANA (BACILLARIOPHYCEAE) AND CHLAMYDOMONAS REINHARDTII (CHLOROPHYCEAE),
Ohio State Univ., Columbus. Dept. of Botany.
K. S. Button, and H. P. Hostetter.
Journal of Phycology, Vol. 13, p 198-202, 1977. 5 fig, 3 tab, 20 ref.

Descriptors: *Copper, *Copper sulfate, *Algicides, *Chlamydomonas, *Aquatic algae, *Adsorption, Membrane processes, *Biological membranes, *Algal control, *Cytological studies, *Metabolism chemical analysis, Mode of action, Water pollution effects, Path of pollutants, *Cyclotella.

Copper sulfate has been used extensively as a practical algicide in algal control programs. Algal control and growth studies have pointed out that different algal species have differing sensitivities to the toxic effects of copper ions. Experiments were performed on two species of algae to determine the rate and quantity of copper sorption, the intensity of binding (copper release), and whether the copper is adsorbed to cell walls and is therefore unavailable to the protoplasm. Levels of copper used in algal control programs were used in the experiments. (Katz) W78-03945

THE EFFECT OF AMBIENT OXYGEN CONCENTRATION ON FILTERING AND RESPIRATION RATES OF DAPHNIA GALEATA MENDOTAE AND DAPHNIA MAGNA,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.

D. Heisey, and K. G. Porter.
Limnology and Oceanography, Vol. 22, No. 5, p. 839-845, 1977. 4 fig, 1 tab, 28 ref.

Descriptors: *Oxygen, *Food webs, *Respiration, *Oxygen requirements, *Oxygen demand, *Metabolism, *Daphnia, Mortality, Eutrophication, Epilimnion, *Zooplankton, Predation, Hypolimnion, Crustacean, Methodology, Laboratory tests, Dissolved oxygen, Animal behavior, Hemoglobin, Reduced dissolved oxygen, Ambient oxygen concentration, Filtering rate.

Filtering and respiration rates for both species were measured in oxygen concentrations ranging from air saturation to near zero, using animals that had lived in air-saturated conditions so that facultative hemoglobin synthesis was not initiated. *D. magna*'s filtering and respiration rates were independent of oxygen concentrations above 0.3 mg/liter; below this, the rates declined rapidly. *D. galeata mendotae*'s filtering and respiration rates exhibited a linear dependence on oxygen concentrations. It was suggested that *D. magna*'s relatively greater tolerance of low oxygen concentrations was due largely to its higher basal levels of hemoglobin. (Katz) W78-03947

EFFECT OF DIETARY ASCORBIC ACID ON THE ACCUMULATION OF COPPER IN CARP,
Kyoto Univ. (Japan). Dept. of Fisheries.
Y. Yamamoto, T. Ishii, M. Sato, and S. Ikeda.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 43, No. 8, p 989-993, 1977. 15 ref, 6 tab, 3 fig, In Japanese with English abstract.

Descriptors: *Copper, *Absorption, *Biochemistry, *Nutrients, *Fish diets, *Growth rates, Metals, Metabolism, Fish physiology, Enzymes, Laboratory tests, Freshwater fish, Fish, Water pollution effects, *Ascorbic acid, Tissue analysis, Bioaccumulation.

This paper deals with the effect of dietary L-ascorbic acid (AsA) on the accumulation of copper in tissues of carp exposed to the copper solution at a level of 0.05 ppm for 9 weeks. The copper content in the hepatopancreas of carp fed the AsA-supplemented diet significantly decreased as compared to that of carp fed the AsA-free diet. Prevention of copper accumulation by AsA intake was also observed in the gills, kidney, intestine, and vertebrae. The AsA content in the hepatopancreas was reduced in proportion to the amount of accumulated copper. Further, the accumulation of copper in the hepatopancreas caused a decrease in the hepatic L-gulonolactone oxidase activity. These results indicated that AsA prevents the accumulation of copper and that accumulated copper decreases the AsA level in the hepatopancreas by inhibiting the biosynthesis of AsA in carp. (Katz) W78-03948

THE ACTIVITY OF DELTA 5-3 BETA HYDROXYSTEROID DEHYDROGENASE ENZYME IN THE INTERRENAL TISSUE OF RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON) EXPOSED TO SUBLETHAL CONCENTRATIONS OF ZINC,
Guelph Univ. (Ontario). Dept. of Zoology.
T. A. Watson, and B. A. McKeown.

Bulletin of Environmental Contamination and Toxicology, Vol. 16, No 7, p 173-181, 1977. 6 fig, 3 tab, 17 ref.

Descriptors: *Salmonids, *Trout, *Rainbow trout, Fish physiology, *Enzymes, *Metals, *Toxicity, *Zinc, Path of pollutants, Mode of action, Metabolism, Biochemistry, Analytical techniques, Mortality, Lethal limit, *Hydrosteroid dehydrogenase enzyme, Tissue analysis, Bioaccumulation, Enzyme activity.

The effects of exposure of rainbow trout (*Salmo gairdneri Richardson*) to three sublethal concentrations of zinc on hydroxy steroid dehydrogenase (HSDH) enzyme activity in the head kidney tissue was investigated. The activity of this enzyme was localized by the reduction of a tetrazolium salt to formazan at the site of activity. Using subjective methods to indicate the degree of activity and indirectly assess the degree of corticosteroid production, the zinc-exposed rainbow trout showed a greater degree of HSDH activity compared to the control fish. This increase in enzyme activity has been associated with the stimulation of the pituitary-interrenal axis by the noxious stress of zinc. (Katz) W78-03949

PROLONGED RETENTION OF METHYL MERCURY BY MALLARD DRAKES,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
For primary bibliographic entry see Field 5B.
W78-03950

APPLICATION OF VARIOUS MATHEMATICAL MODELS TO DATA FROM THE UPTAKE OF METHYL MERCURY IN BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W78-03951

AN ENVIRONMENTAL INDEX BASED ON RELATIVE ABUNDANCE OF OLIGOCHAETE SPECIES,
California Univ., Santa Barbara.
For primary bibliographic entry see Field 5A.
W78-03954

SEASONAL CHANGES IN THE EFFECTS OF TEMPERATURE AND WATER FLOW RATE ON THE GROWTH OF JUVENILE PACIFIC OYSTERS, CRASSOSTREA GIGAS (THUNBERG),
Oregon State Univ., Newport. Dept. of Fisheries and Wildlife.
R. E. Malouf, and W. P. Breese.
Aquaculture, Vol. 12, p 1-13, 1977. 7 fig, 3 tab, 20 ref.

Descriptors: *Seasonal, *Water temperature, *Growth rates, *Growth stages, *Juvenile growth stage, *Oysters, *Flow rates, *Suspended load, *Suspended solids, *Nuclear powerplants, *Thermal pollution, *Food abundance, Commercial shellfish, Shellfish farming, Animal physiology, Animal metabolism, Aquaculture.

This study, initiated because of local interest in the feasibility of using heated power plant effluents in the culture of the Pacific oyster, sought to investigate seasonal changes in the effects of temperature and water flow rate on the growth of oysters. The results show profound seasonal

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changes in the growth rate of immature Pacific oysters. These growth fluctuations are independent of temperature and appear to be related to changes in the quantity of particulate material suspended in the water. Hypothetical curves relating temperature, food availability and oyster growth are proposed. The form of these curves, which is based on observed relationships and on similar studies involving other aquatic organisms, suggest that under ideal conditions, and with high food availability maximum growth might be achieved at temperatures approaching 20°C. (Katz) W78-03956

THE EFFECT OF SALINITY UPON PHOTOTAXIS AND GEOTAXIS IN A LARVAL CRUSTACEAN,
Duke Univ., Beaufort, NC. Marine Lab.
M. I. Latz, and R. B. Forward, Jr.
Biological Bulletin, Vol. 153, p 163-179, 1977. 5 fig, 2 tab, 37 ref.

Descriptors: *Salinity, *Saline water, *Salt tolerance, *Larvae, *Larval growth stage, *Crabs, *Light intensity, Salts, Water properties, Metabolism, Resistance, Crustaceans, *Phototaxis, *Geotaxis, Rhithropanopaeus.

Larvae were exposed to sudden salinity changes and stimulated with various intensities of 500-wm light in the horizontal plane. Although the pattern of phototaxis of larvae exposed to 40% was unchanged from that at 20% (acclimation salinity), the level of positive phototaxis to higher intensities was significantly greater and the level of negative phototaxis to low intensities was significantly lower at 40%. Exposure to low salinity sea water (5%) generally reverses the sign of phototaxis, since a significantly higher level of negative phototaxis and lower level of positive phototaxis occurs at light intensities above 10-2Wm-2. Anesthetized larvae sink in both high and low salinity water. Thus, the ascent in high salinities does not result from floating due to the increased density of the water. A comparison of descent rates by anesthetized and unanesthetized larvae in 0.15 Wm-2 light directed from above and in low salinity water indicates that the normal descent results primarily from active downward swimming, although some larvae exhibit passive sinking. These behavioural responses to increases and decreases in salinity can act as a negative feedback system to keep larvae within the region of acclimation salinity water in the vertical water column. (Katz) W78-03957

BIOKINETICS OF NEPTUNIUM-237 IN MUSSES AND SHRIMP,
International Lab. of Marine Radioactivity, Monte Carlo (Monaco). Oceanographic Museum.
J. C. Guary, and S. W. Fowler.
Marine Science Communications, Vol. 3, No. 3, p 211-229, 1977. 5 fig, 1 tab, 15 ref.

Descriptors: *Radioactive wastes, *Radioisotopes, *Radiochemical analysis, *Shrimp, *Mussels, *Growth rates, *Nuclear wastes, *Growth stages, *Animal metabolism, Animal physiology, *Adsorption, Path of pollutants, Crustaceans, *Neptunium-237, Molting, Bioaccumulation, Lysmata, Tissue analysis.

Neptunium-237, kinetics were studied in marine shrimp and mussels using a thick source alpha counting technique. Bioaccumulation of 237 Np from water was relatively slow in both species, reaching whole body concentration factors of only 15 to 20 after three months. Surface adsorption was implicated in the initial uptake. Both uptake and loss of the radioisotope were not significantly affected by temperature. By virtue of the large amounts of accumulated 237Np associated with the exoskeleton of shrimp, molting will play an important role in the biogeochemical cycling of this transuranic in the marine environment. (Katz) W78-03959

A STUDY ON THE ENVIRONMENTAL FACTORS IN AN EEL POND: III. LOW REDOX POTENTIAL OF THE POND SOIL IN MARCH 1972, (IN JAPANESE),
Freshwater Fisheries Research Lab., Tokyo (Japan).

For primary bibliographic entry see Field 2G. W78-03960

DATA ON THE HYGIENIC STANDARDIZATION OF C2 - C5 POTASSIUM XANTHATES IN BODIES OF WATER, (IN RUSSIAN),
Novosibirsk Sanitary Research Inst. (USSR).
E. M. Trofimovich, S. M. Rykova, M. A. Molchanova, and L. B. Aleksandrovskaya.
Gig Sanit 6, p 95-97, 1976.

Descriptors: *Water quality standards, Public health, *Water pollution effects, Self-purification, Kidney, Liver, Mouse, Pathology, *Potassium xanthate, Stomach, Toxicity, *Xanthates.

Various effects of potassium xanthates, widely used in ore enrichment, were studied. On the basis of their effect on self-purification processes of water (biochemical O2 demand), threshold concentrations were 0.5 mg/l ethyl, 10 mg/l isopropyl, 0.5 mg/l isobutyl and 0.1 mg/l isoamyl potassium xanthate. Experiments in which mice and rats were given intragastric doses of these 4 compounds revealed the similarity of their toxic effects. The level of acute toxicity of the compounds increased with their molecular weight. In chronic experiments, ethyl and isoamyl potassium xanthates caused disturbances in tissue redox processes and pathological changes in the liver, kidneys, stomach and CNS. Their inactive doses were established at 0.5 mg/kg. For potassium xanthates, the limiting index of harmfulness should be the organoleptic index, and maximum permissible concentrations in bodies of water should be 0.1 mg/l ethyl, 0.05 mg/l isopropyl, and 0.005 mg/l isobutyl and isoamyl potassium xanthate. Copyright 1978, Biological Abstracts, Inc.

W78-03966

EFFECTS OF SELECTED WASTEWATER CHLORINATION PRODUCTS AND CAPTAN ON MARINE ALGAE,
Syracuse Research Corp., NY.

H. C. Sikka, and G. L. Butler.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 100, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency, Ecological Research Series, Report EPA 600/3-77-029, March 1977, 37 p, 1 tab, 16 fig, 4 ref.

Descriptors: *Chlorination, Chlorine, Domestic wastes, Sewage, *Sewage treatment, *Algae, *Phytoplankton, *Water pollution effects, Algal-phenes, Bioassay, Sea water, Dunaliella, Skeletonema, Porphyridium, Chlorobenzoic acid, *Chlorophenol, Chlororesorcinol, *Captan, *Chloro-organic compounds, Marine unicellular algae.

Effects of stable chloro-organic compounds formed during chlorination of sewage effluents on growth of marine unicellular algae were determined. Captan suppressed growth of Dunaliella tertiolecta and Porphyridium cruentum at 5 ppm. Growth of Skeletonema costatum was inhibited by 0.25 ppm captan. 3-Chlorobenzoic acid inhibited growth of S. costatum at 10 ppm but had no effect on D. tertiolecta or P. cruentum. There was no effect of 1-10 ppm 5-chlorouracil on S. costatum, but growth of D. tertiolecta was stimulated initially. Growth of S. costatum was inhibited by 1 ppm 4-chlororesorcinol, and 10 ppm inhibited growth of P. cruentum. At 1 ppm, 3-chlorophenol stimulated growth of all three species, but growth of S. costatum was inhibited by 2.5 ppm. A combination of 3-chlorophenol and 4-chlororesorcinol interacted synergistically to reduce growth of S.

costatum. It is concluded that chloro-organic compounds formed during chlorination of sewage effluent are not an immediate threat to marine unicellular algae. (Katz) W78-03971

EFFECTS OF SUBLETHAL METAL POLLUTANTS ON THE FIDDLER CRAB UCA PUGILATOR,
South Carolina Univ., Columbia. Beile W. Baruch Inst. for Marine Biology and Coastal Research.

W. B. Vernerberg, and P. J. DeCoursey.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 940, Price codes: A14 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-024, February 1977, 58 p, 1 tab, 44 fig, 37 ref.

Descriptors: Crustaceans, *Crabs, *Toxicity, Bioassay, Mortality, *Metals, *Mercury, *Cadmium, Animal behavior, Oxygen, Oxygen demand, Animal physiology, Methodology, Heavy metals, Enzymes, Pathology, Temperature, Salinity, Laboratory tests, Synergistic effects, *Sublethal concentrations, *Fiddler crabs, Uca pugilator, Crab larvae, Oxygen consumption, Sublethal dosage, Tissue uptake, Metabolism, Microscopic anatomy, Enzymatic activity, *Mode of action.

Studies have been carried out on the synergistic effects of sublethal concentrations of mercury (Hg) and/or cadmium (Cd) in conjunction with temperature and salinity stress on larval and adult fiddler crabs, Uca pugilator. Six biological parameters of the adult organism were monitored including survival, tissue uptake, metabolism, behavior, microscopic anatomy, and enzymatic activity, using metal concentrations of 0.18 ppm Hg and 1.0 ppm Cd. Studies with larval stages (zoal stages I, III, V and megalops) considered survival, metabolism, and behavior under conditions of 1.8 ppb Hg and 1.0 ppb Cd. The effect of mercury or cadmium on Uca pugilator depends upon a number of factors, including stage of the life cycle, sex, thermal history, and environmental conditions. Data presented here suggest that the mode of action of the two metals is not the same. (Katz) W78-03972

SUSPENDED AND DISSOLVED SOLIDS EFFECTS ON FRESHWATER BIOTA: A REVIEW,
Utah State Univ. Foundation, Logan; and Utah Water Research Lab.

D. L. Sorenson, M. M. McCarthy, E. J. Middlebrooks, and D. B. Porcella.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 180, Price codes: A04 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-042, April 1977, 64 p, 1 fig, 7 tab, 185 ref.

Descriptors: Review, *Suspended solids, *Sediments, *Turbidity, *Dissolved solids, Salinity, Freshwater fish, Invertebrates, Zooplankton, Algae, Water supply, Livestock, Aesthetics, Nutrients, Chlo-inated hydrocarbon pesticides, Erosion, Standards, Research priorities, Lakes, Reservoirs, Streams, *Total dissolved solids, Conductivity.

It is widely recognized that suspended and dissolved solids in lakes, rivers, streams, and reservoirs affect water quality. In this report the research needs appropriate to setting freshwater quality criteria or standards for suspended solids (not including bedload) and dissolved solids are defined by determining the state of our knowledge from a critical review of the recent literature in this field. Although some 185 journal articles, government reports, and other references were cited herein, there is a dearth of quantitative information on the response of freshwater biota, especially at the community level, to suspended and dissolved solids. The major research need was

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defined as the development and/or application of concepts of community response to suspended and dissolved solids concentrations and loads. These concepts need to be applied especially to the photosynthetic, the microfauna, and macrofauna levels. Fish studies are of lower priority since more and better research has been reported for these organisms. In addition, the role of suspended solids in transporting toxic substances (organics, heavy metals), aesthetic evaluation of suspended solids in aquatic ecosystems, and dissolved solids in drinking water, and economic aspects of dissolved solids in municipal-industrial water were defined as research needs. (Katz) W78-03973

CHRONIC TOXICITY OF METHOXYCHLOR, MALATHION AND CARBOFURAN TO SHEEPSHEAD MINNOWS (CYPRINODON VARIEGATUS), EG and G Biometrics, Pensacola, FL. Marine Research Lab.

P. R. Parrish, E. E. Dyar, M. A. Lindberg, C. M. Shanika, and J. M. Enos. Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 102, Price codes: A06 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-059, May 1977, 36 p, 27 tab, 35 ref.

Descriptors: *Bioassay, *Toxicity, Mortality, Laboratory tests, Marine fish, *Chlorinated hydrocarbon pesticides, Pesticides, Fish eggs, Lethal limit, *Fish reproduction, Methodology, Water pollution effects, Lethal limit, Pollutant identification, *Methoxychlor, *Malathion, *Carbofuran, Cyprinodon, Maximum acceptable toxicant concentration, Juvenile fish.

Sheepshead minnows (*Cyprinodon variegatus*) were exposed to each of three pesticides—methoxychlor, malathion, and carbofuran—in flowing seawater to determine the acute and chronic (partial life-cycle) effects. Mortality of adult fish exposed to concentrations of methoxychlor greater than or equal to 23 microgram/l and hatching success of fry from eggs spawned by fish exposed to 23 microgram/l were significantly different from the control. The maximum acceptable toxicant concentration (MATC) was estimated to be greater than 12 and less than 23 microgram/l; application factor (AF) limits were 0.24-0.47. Mortality of adult fish exposed to concentrations of malathion greater than or equal to 18 microgram/l and mortality of fry hatched from eggs spawned by fish exposed to 9 and 18 microgram/l were significantly different from the control. The MATC was estimated to be greater than 4 and less 9 microgram/l; AF limits were 0.08-0.18. Mortality of adult fish exposed to concentrations of carbofuran greater than 49 microgram/l, hatching success of fry from eggs spawned by fish exposed to 49 microgram/l, and mortality of fry hatched from eggs spawned by fish exposed to 23 and 49 microgram/l were significantly different from the control. The MATC was estimated to be greater than 15 and less than 23 microgram/l; AF limits were 0.04-0.06. (Katz) W78-03974

TOXICITY OF DIAZINON TO BROOK TROUT AND FATHEAD MINNOWS, Environmental Research Lab.-Duluth, MN.

D. T. Allison, and R. O. Hermanutz. Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 293, Price codes: A05 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-060, May 1977, 68 p, 15 tab, 22 ref, 4 append.

Descriptors: *Diazinon, *Insecticides, *Toxicity, Bioassay, Mortality, Methodology, Laboratory tests, Laboratory equipment, Freshwater fishes, *Brook trout, Water pollution effects, Fish physiology, Pathology, *Organophosphorous pesticides, Fish eggs, Sunfish, Pollutant identification, *Skeletal deformities, Scoliosis, Lordosis,

*Fathead minnows, *Pimephales*, *Salvelinus*, *Acute toxicities, Flagfish, Bluegills.

Fathead minnows exposed to diazinon from 5 days through 24 weeks post hatch developed severe scoliosis. The incidence and degree of spinal deformity correlated to exposure level. Fish in 3.2 microgram/l (the lowest concentration tested) had 60% more deformities than controls ($P=0.05$). Hatch of eggs from fathead minnows exposed to 3.2 microgram/l was 30% lower than the controls. Yearling brook trout exposed to 4.8 microgram/l and above developed scoliosis and lordosis within a few weeks. Growth was substantially inhibited ($P=0.05$) during the first 3 months of exposure at 4.8 microgram/l and above. Exposure to 2.4 microgram/l and above caused frequently observed neurological symptoms for the first 4 to 5 months. Progeny of parents exposed to 6 to 8 months to all levels tested (0.55 to 9.6 microgram/l) were smaller than controls at 122 days post hatch ($P=0.05$). Acute toxicity tests with diazinon yielded 96-hr LC₅₀'s of 7.8, 1.6, 0.77, and 0.46 mg/l respectively for fathead minnows, flagfish, brook trout and bluegills. (Katz) W78-03975

TEMPERATURE CRITERIA FOR FRESHWATER FISH: PROTOCOL AND PROCEDURES, Environmental Research Lab.-Duluth, MN.

For primary bibliographic entry see Field 5G. W78-03976

A RAPID ASSESSMENT OF THE TOXICITY OF THREE CHLORINATED CYCLODIENE INSECTICIDE INTERMEDIATES TO FATHEAD MINNOWS, Environmental Research Lab.-Duluth, MN.

For primary bibliographic entry see Field 5A. W78-03977

SURVIVAL AND IMMUNE RESPONSE OF COHO SALMON EXPOSED TO COPPER, Corvallis Environmental Research Lab., Oreg.

D. G. Stevens. Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 291, Price codes: A03 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-031, March 1977, 36 p, 10 tab, 14 fig, 43 ref.

Descriptors: *Aquaculture, *Fish diseases, Bacteria, *Copper, Metals, Bioassay, Toxicity, Mortality, Laboratory tests, Juvenile fish, *Salmon, Sea water, Fish physiology, Stress, *Coho salmon, **Vibrio anguillarum*, Vaccination, *Seawater adaptation.

Vaccination with *Vibrio anguillarum* by oral administration during copper exposure and intraperitoneal injection prior to copper exposure was employed to investigate the effects of copper upon survival and the immune response of juvenile coho salmon (*Oncorhynchus kisutch*). Following copper exposure the survivors were challenged under natural conditions to *V. anguillarum*, the causative agent of vibriosis in fish. Copper concentrations of 18.1 ug/liter and higher caused significant mortality among coho fry during 30 days of exposure. The exposure of copper bioassay survivors to a natural challenge against *V. anguillarum* in seawater caused significant mortality among those fish from concentrations of copper at 13.9 ug/liter and higher. The reduced number of dead fish positive for *V. anguillarum* from the challenge suggests that sublethal copper stress and difficulty with seawater adaptation may have caused several deaths. Significant mortality occurred among coho fingerlings exposed to 24.6 ug/liter copper and higher for 31 days. Most of the survivors of these concentrations were unable to adapt to seawater and died within the first three days of challenge. Significant mortality also occurred during adaptation of survivors from 18.2

ug/liter copper where the mean mortality resulting from 31 days exposure was only 2%. The antibody level against *V. anguillarum*, measured by agglutinin titer, was significantly reduced in fish exposed to this concentration of copper when compared to that developed in control animals. (Katz) W78-03978

PLANKTON STUDIES IN A MANGROVE ENVIRONMENT: VIII. FURTHER INVESTIGATIONS ON PRIMARY PRODUCTION, STANDING STOCK OF PHYTO- AND ZOOPLANKTON AND SOME ENVIRONMENTAL FACTORS, Universidade Federal Sao Carlos, Sao Paulo (Brazil). Dept. of Biology. J. Tundisi, T. M. Tundisi, and M. B. Kutner. Int Rev Gesamten Hydrobiol. 58(6), p 925-940, 1973.

Descriptors: *Estuarine environment, Cananeia (Brazil), Seasonal, Climates, Environment, *Environmental effects, Eutrophication, *Mangrove, Nutrition, *Phytoplankton, *Primary production, Standing stock, *Zooplankton.

At one station in a mangrove region of the estuarine type (25 degrees S, Cananeia, Brazil) monthly studies of the primary production of phytoplankton, standing stock, and climatological and environmental factors were conducted from March 1967-Fe. 1968. The area is moderately to highly productive throughout the year (0.10-0.88 cal/m²/day). During the summer higher rates of primary production were obtained. The general hydrographic conditions indicate a possible eutrophication of the ecosystem during the summer. Nanophytoplankton constitutes the bulk of the phytoplankton standing stock during most of the year; in summer an increase of microphytoplankton occurs. The results for the standing stock of phyto- and zooplankton indicate a possible annual cycle. This would be the consequence of the temperature and better nutritional conditions during the summer. A comparison with other tropical or subtropical areas indicates relatively high production for the environment studied. Enrichment studies could be the key to understanding certain aspects of the seasonal cycle of phytoplankton and primary production in tropical waters. Copyright 1975, Biological Abstracts, Inc. W78-04017

METABOLISM AND MODEL OF AN ESTUARINE BAY ECOSYSTEM AFFECTED BY A COASTAL POWER PLANT, South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research. H. N. McKellar, Jr. Ecological Modeling, Vol. 3, 1977, p 85-118, 11 fig, 6 tab, 46 ref.

Descriptors: *Environmental effects, *Thermal pollution, *Water pollution, Estuaries, *Model studies, *Metabolism, Biomass, On-site investigations, Plankton, Powerplants, Discharge(Water), Biological communities.

Field measurements of community metabolism and biomass and an ecological model were used to evaluate the effect of the Crystal River Powerplant on an outer estuarine bay ecosystem. The discharge bay in comparison with control bays demonstrated lower biomass and slightly faster rates of organic turnover. Less than 10% difference in annual averages of total community metabolism was observed between the discharge and control bays. Annual average gross plankton production was approximately 3 g O₂/square m/day in the discharge bay and 2 g/square m/day in the control bays. The selection for smaller biomass and faster turnover was indicated in the selection for plankton populations over benthic components in the outer discharge bay. In the model, effects of increased temperature were in agreement with observations from field measure-

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HEAVY TARIC Toronto Studies. J. R. B. Bulletin Toxic ref, 19

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

ments. Simulations of several levels of total water exchange indicated the importance of water exchange as a stabilizing factor. (Chilton-ORNL) W78-04036

HEAVY METAL CONCENTRATIONS IN ONTARIO FISH, Toronto Univ. (Ontario). Inst. for Environmental Studies.

J. R. Brown, and L. Y. Chow. Bulletin of Environmental Contamination and Toxicology, Vol 17, No 2, p 190-195. 2 fig, 2 tab, ref. 1977.

Descriptors: *Environmental effects, *Water pollution, *Heavy metals, Fish, Canada, *Lake Huron, Cadmium, Copper, Lead, Zinc, Mercury.

The study concerns the distribution of heavy metals in fish samples taken from Lake Huron at Baie du Dore and Toronto Harbour during 1973. Toronto Harbour represents a high level of pollution and Baie du Dore a minimum level. The ratios for cadmium, copper, lead, zinc and mercury in fish muscle between Baie du Dore and Toronto Harbour were 1:2, 1:4, 1:9, 1:8, and 1:4 respectively. The relative abundance of these metals in fish muscle from both areas was, in ascending order, cadmium, mercury, lead, copper and zinc, whereas, in sediment it was mercury, cadmium, copper, lead and zinc. (Chilton-ORNL) W78-04039

MERCURY CONTENT IN SEVERAL SPECIES OF MARINE FISH, Genoa Univ. (Italy). Ist. di Farmacologia e Farmacognosia.

For primary bibliographic entry see Field 5A. W78-04041

BIOLOGICAL STUDY OF THE SUBMARINE SHELF OF CATALUNIA, (IN SPANISH), Barcelona Univ. (Spain). Catedra Botany.

For primary bibliographic entry see Field 2L. W78-04043

EFFECTS OF CHEMICAL POLLUTION ON TELEMEEDIATORS INTERVENING IN THE MICROBIOLOGICAL AND PLANKTONIC ECOLOGY IN A MARINE ENVIRONMENT, PART II, (IN FRENCH), Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale, Nice (France). M. Aubert, M. Gauthier, and D. Pesando. Rev Int Oceanogr Med. 37/38, p 69-88, 1975.

Descriptors: Water pollution effects, *Diatoms, Copper, Zinc, Chromium, Lead, Mercury, *Bacteria, Alteromonas, Asterionella japonica, *Chemical pollution, Ecology, Environment, Marine environment, *Microbiological ecology, Plankton, Pollution, Pseudomonas, *Telemediators.

The action of Cu, Zn, Cr, Pb and Hg on the growth and antibiotic function of a marine diatom, Asterionella japonica, and 2 bacteria isolated from sea water (Pseudomonas and Alteromonas) was studied. The toxicity of these metals towards the test organisms varies according to their chemical state. Some of these metals, whether complexed or not, inhibit or increase the production and release of the antibiotic mediators at sublethal concentrations. (See also W76-12922 and W73-10095) Copyright 1975, Biological Abstracts, Inc. W78-04044

ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON: IX. STUDIES RELATING TO THE NUTRITION OF OVER-WINTERING CALANUS, Marine Biological Association of the United Kingdom, Plymouth (England). Plymouth Lab.

E. D. S. Corner, R. N. Head, C. C. Kilvington, and S. M. Marshall. J Mar Biol Assoc U K. 54(2), p 319-331, 1974.

Descriptors: *Nitrogen, *Phosphorus, Sea water, Clyde sea coast (England), *Calanus helgolandicus, Diatoms, Elminius modestus, *Metabolism, *Nutrition, *Zooplankton.

Studies were made relating to the problem of how Calanus feeds during winter in the Clyde (England) sea-area. Different diets were assessed in terms of sustaining the levels of body N and P in Calanus helgolandicus (Claus) over a period of several days. The test diets, all equivalent to the same level of particulate N in sea water, were: (1) suspended matter collected from the Clyde sea-area in winter; (2) particulate material produced in a foam-tower by bubbling sea water enriched with soluble extracts of plant cells; (3) living nauplii of the barnacle Elminius modestus Darwin; (4) dead nauplii of this species. Neither body N nor body P was sustained by diet 1; that body N, but not body P, was sustained by diet 2; that both were sustained by either of diets 3 and 4. With living Elminius nauplii as the food, each Calanus captured the equivalent of 25% of its body nitrogen and 47.3% of its body P daily: with dead nauplii as the food the corresponding values were 34.4 and 44.5%. These ratios are much higher than those found in an earlier study of Calanus grazing on a spring diatom increase in the Clyde and demonstrate that animal diets are readily captured. In general, the results indicate that Calanus could survive the winter in the Clyde sea-area by feeding carnivorously. (See also W71-0496 and W70-05997) Copyright 1974, Biological Abstracts, Inc. W78-04045

MERCURY IN CATFISH AND BASS FROM THE SNAKE RIVER IN IDAHO, Idaho State Dept. of Health and Welfare, Boise. Epidemiologic Studies Program.

For primary bibliographic entry see Field 5A. W78-04047

MULTIFARIOUS POWER PLANT WATER INTAKE STRUCTURE (MWIS) A DESIGN CONCEPT TO REDUCE THE ENVIRONMENTAL EFFECTS OF COOLING WATER INTAKE STRUCTURES, New York State Energy Research and Development Authority, New York.

For primary bibliographic entry see Field 81. W78-04048

INVESTIGATIONS ON THE PROTECTION OF FISH LARVAE AT WATER INTAKES USING FINE-MESH SCREENING, Tennessee Valley Authority, Norris. Div. of Forestry, Fisheries, and Wildlife Development. For primary bibliographic entry see Field 81. W78-04049

THE PHYSICAL EFFECTS OF ENTRAINMENT - CURRENT RESEARCH AT ORNL, Oak Ridge National Lab., TN. Environmental Sciences Div.

For primary bibliographic entry see Field 81. W78-04050

IMPACT OF COOLING WATERS ON THE AQUATIC RESOURCES OF THE PACIFIC NORTHWEST, National Marine Fisheries Service, Seattle, WA. D. R. Craddock. Marine Fisheries Review, Vol 38, No 11, 1976. p 27-34, 4 fig, 29 ref.

Descriptors: *Environmental effects, *Thermal pollution, *Water pollution, Powerplants, Aquatic environment, Discharge (Water), Water cooling, Nuclear powerplants, *Pacific Northwest, *Columbia River.

The paper reviews the physical and biological effects of cooling waters on the aquatic environment of the Pacific Northwest. A survey of the lower Columbia River revealed 19 thermal pollution outfalls between Bonneville Dam and the mouth of the river which it was calculated put sufficient heat into the river during the summer to raise the temperature of the entire flow by 0.3C. The impact of thermal effluent on marine resources is small at the present time but the bulk of electrical power in area is from hydropower generation. Predictions for future needs, which will be supplied mainly by thermal nuclear generation, are so great that it was concluded that if once-through cooling is employed, vast quantities of heated water will be added to the aquatic environment. It is suggested that the construction of 20 or more thermal nuclear plants may have a significant impact on marine resources in the area. (Chilton-ORNL) W78-04052

THE EFFECTS OF STEAM ELECTRIC STATION OPERATION ON ENTRAINED PHYTOPLANKTON, Maryland Univ., Solomons. Chesapeake Biological Lab.

D. Flemer, and J. A. Sherk, Jr. Hydrobiologia, Vol 55, No 1, July 1977. p 33-44, 4 fig, 6 tab, 22 ref.

Descriptors: *Environmental effects, Powerplants, Cooling water, *Entrainment, *Phytoplankton, Temperature, Thermal stress, Photosynthesis, Chlorination, Intake structures, Mechanical stress.

The rate of C 14-uptake, an index of photosynthetic rate, and the concentration of chlorophyll a, a measure of standing crop, were measured to estimate the effects of entrainment on phytoplankton. The rate of carbon assimilation appeared to depend on the ambient water temperature and the temperature rise experienced by the entrained organisms. It was concluded that the reduction in carbon assimilation was greater than could be explained by the effects of mechanical and thermal stress and that chlorine was an important factor in the reduction. (Chilton-ORNL) W78-04053

THE EFFECT OF SEWAGE ON THE INFESTATION OF KAMA RESERVOIR FINGERLINGS BY BROAD TAPEWORM PLEROCERCIDS, (IN RUSSIAN), All-Union Scientific Research Inst. of Medical Parasitology and Tropical Diseases, Moscow (USSR).

A. S. Artamoshin, and V. I. Khodakova. Gidrobiol Zh 12(6), p 89-91, 1976.

Descriptors: *Sewage effluents, Water pollution effects, *Tapeworms, *Kama Reservoir (USSR), Chlorides, Nitrates, Hydrogen sulfide, Acerina cernua, Copepods, Diphyllobothrium latum, Esox lucius, *Parasites, Perca fluviatilis.

The invasion of Perca fluviatilis, Esox lucius and Acerina cernua fingerlings by Diphyllobothrium latum plerocercoids was studied in the Kama Reservoir and its tributaries near Solikamsk and Uso'l'e (Russian SFSR, USSR). The release of untreated domestic sewage into the water resulted in fish infestation, but the incidence of infestation was lower in areas where industrial waste were mixed with the domestic sewage. This is probably the result of the harmful effect of chemicals (e.g. Cl, N, hydrogen sulfide) on the eggs, intermediate hosts (copepods) and supplementary hosts (the studied fingerlings). Copyright 1978, Biological Abstracts, Inc. W78-04055

EFFICIENCY OF NETS AND A NEW DEVICE FOR SAMPLING LIVING FISH LARVAE, Lawler, Matusky, and Skelly, Tappan, NY. For primary bibliographic entry see Field 81.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

W78-04056

THERMAL EFFECTS OF POWER PLANT ENTRAINMENT ON SURVIVAL OF LARVAL FISHES: A LABORATORY ASSESSMENT, New York State Univ. at Stony Brook. Marine Sciences Research Center. J. R. Schubel, C. F. Smith, and T. S. Y. Koo. Chesapeake Science, Vol 18, No 3, September 1977, p 290-298, 2 fig, 5 tab, 25 ref.

Descriptors: *Environmental effects, *Thermal pollution, *Water pollution effects, Entrainment, Fish, Larvae, Temperature, Powerplants, Laboratory tests, *Bass, *Herrings, Resistance, Shad.

Time-excess temperature studies were conducted using larvae of blueback herring, American shad, and striped bass. Striped bass showed the greatest thermal tolerance of the three species. Exposure to temperatures 20°C above base temperature resulted in almost total mortality of all three species within two minutes of the initial exposure. Exposure of striped bass to a maximum excess temperature of up to 10°C did not significantly increase their mortality. Exposure of American shad to a maximum excess temperature of 7°C significantly increased mortality, while exposure to a maximum excess temperature of 8°C did not. Exposure of blueback herring to maximum excess temperatures of 7 and 8°C significantly increased mortality. It was concluded that thermal response is a dose response and that more research is required before thermal standards can be set. (Chilton-ORNL) W78-04057

MICROBIOLOGICAL CHARACTERISTICS OF LAKES IN THE YAROSLAVL OBLAST, (IN RUSSIAN), N. A. Lapteva, and S. V. Monakova. Mikrobiologiya 45(4), p 717-723, 1976.

Descriptors: Lakes, Microbiology, Water pollution effects, *Bacteria, Carbon dioxide, Photosynthesis, *Phytoplankton, USSR, Yaroslavl Oblast(USSR).

Data was given on the activity of microflora in water and ooze deposits of lakes of the Yaroslavl region (Ukrainian SSR, USSR). Microbiological processes in water depend mainly on the rate of production of organic substances and phytoplankton photosynthesis, which varies from 0.18-6.3 gC/m². Destruction of organic substance in water of most lakes exceeded production. Production of bacterial biomass was within limits of 0.2-5.8 gC/m²/day and lower, as a rule, than production of phytoplankton. The number of bacteria in different lakes varied from 1.7 to 35 x 10 to the sixth power/ml. Heterotrophic assimilation of CO₂ was rather high and reached 34 mcgC/l per day, its ratio to biomass about 6.8%. The total number of bacteria in ooze deposits of lakes varied from 0.6 to 2.7 x 10 to the ninth power g/m². Aerobic destruction varied from 0.3-0.78 gC/m². Copyright 1978, Biological Abstracts, Inc. W78-04058

MORTALITY OF STRIPED BASS EGGS AND LARVAE IN NETS.

New York Univ. Medical Center, NY. Lab. for Environmental Studies.

A Special Report to Consolidated Edison Company of New York, Inc., July 1976. 21 p, 4 fig, 3 tab, 5 ref.

Descriptors: *Environmental effects, Powerplants, Discharge(Water), Plankton, *Bass eggs, Larvae, Mortality, Sampling, *Nets.

The combined effects of sampling nets and water velocity on striped bass eggs and larvae were determined by releasing living organism directly onto nets submerged in a water flow and observing survival. Immediate and latent observations of the

organism's mortality were recorded along with retention of fish and eggs in the nets. It was concluded that only the velocity of the water being sampled had a significant effect on the survival of net-caught ichthyoplankton. It was suggested that mortality of ichthyoplankton in power plant discharges is a combination of net mortality and plant-induced stress and that if the contribution of net mortality is ignored, power plant impact on ichthyoplankton may be greatly overestimated. (Chilton-ORNL) W78-04059

EFFECT OF SHEAR ON EGGS AND LARVAE OF STRIPED BASS, MORONE SAXATILIS, AND WHITE PERCH, M. AMERICANA, Maryland Univ., Solomons. Chesapeake Biological Lab. and Estuarine Studies.

For primary bibliographic entry see Field 81. W78-04060

SHELL SIZE - FREQUENCY DISTRIBUTIONS OF CORBICULA MANILENSIS PHILIPPI FROM A CLAM-FOULED STEAM CONDENSER, Texas Univ. at Arlington. Dept. of Biology. For primary bibliographic entry see Field 81. W78-04061

AQUATIC IMPACT ASSESSMENT AT CALVERT CLIFFS,

Martin Marietta Environmental Technology Center, Baltimore, MD.

W. A. Richkus.

Record of the Maryland Power Plant Siting Act, Vol. 6, No. 1, April 1977, p 1-7, 4 fig, 1 tab, 8 ref.

Descriptors: *Environmental effects, *Powerplants, Cooling water, Populations, Monitoring, Design criteria, Assessments.

The primary goal of the assessment program at Calvert Cliffs is to find to what extent the plant operation damages the Bay's resources. The assessment provides factual bases for two pending regulatory decisions: (1) determining if cooling must be retrofitted to ensure the protection and propagation of balanced indigenous populations in the Bay; (2) deciding what changes in the operation or design of the once-through cooling system may be needed to minimize stress on organisms. From the major findings of the monitoring program it was concluded that the few measurable plant effects on important Bay species are too localized or transient to be consequential in a regional context. (Chilton-ORNL) W78-04062

EFFECTS OF PULP INDUSTRY EFFLUENTS ON SALMON FRY AND GREEN ALGAE (EFFECTER AV NOEN CELLULOSEINDUSTRIELLE AVLOPSPANN PA LAKSEYNGEL OG GRONNALGER), Norsk Inst. for Vannforskning, Blindern. M. Laake, and M. Grande. Nordforsk Miljøverdsssekretariatet Publication, p 151-163, 1976. 3 fig, 13 ref, 5 tab.

Descriptors: *Pulp wastes, *Water pollution effects, *Salmon, *Algae, *Sulfite liquors, Wastes, Industrial waste, Effluents, Pulp and paper industry, Bleaching wastes, Hydrogen ion concentration, Aquatic life, Microorganisms, Fish, Aquatic animals, Water pollution sources, White water(Paper machine), Condensates, Spent sulfite liquors.

Studies are presented on the influence of spent sulfite liquor, condensate, pulp bleaching wash water (chlorination and alkaline extraction stages), and paper machine white water on receiving waters, particularly with respect to survival of salmon fry and green algae. Spent sulfite liquor had the strongest effect on the fish. Condensate and

bleaching wash water had mainly a pH effect. Green algae were less sensitive to the effluents than salmon fry. (Speckhard-IPC) W78-04063

RECLAMATION OF POLLUTED FARM PONDS,

Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 5G. W78-04098

ACID SNOW-MELT EFFECTS ON WATER QUALITY AND FISH SURVIVAL IN THE ADIRONDACK MOUNTAINS OF NEW YORK STATE

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.

C. L. Schofield.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 801, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, November 1977. 27 p, 9 fig, 6 tab, 17 ref. OWRT A-072-NY(1), 14-34-0001-7068.

Descriptors: *Snow, *Acid precipitation, Fish, *Aluminum, Water chemistry, *Snowmelt, Water quality, *Fish mortality, *New York(Adirondack Mountains), Water pollution effects, *Brook trout, *Toxicity, Hydrogen ion concentration, Nitrate-sulfate ratio, Pollutant identification.

Water quality changes associated with acid snowmelt episodes and effects on fish survival were investigated in the Adirondack Mountains of New York. Relatively high NO₃/SO₄ ratios observed in winter precipitation and snowmelt runoff suggested that nitric acid was a major strong acid component. Snow pack storage of strong acid, concentration by ion separation during thaws, and release in snowmelt led to severe changes in quality of lake and stream water. Decreased pH and high aluminum concentration in run-off were lethal to captive brook trout populations. Aluminum was the major toxic entity present in acid, snowmelt runoff. Aluminum concentrations of 0.25-1.0 mg/liter at pH 4.4-5.9 resulted in severe gill damage and mortality to brook trout fry. At pH 4.0, aluminum concentrations up to 1.0 mg/l had no toxic effects, but rather were antagonistic to hydrogen ion toxicity. Above pH 4.0, increasing pH enhanced the toxicity of aluminum to brook trout. W78-04104

ASSESSMENT OF WATER QUALITY STATUS AND TRENDS IN MINNESOTA BY REMOTE SENSING TECHNIQUES

Minnesota Univ., Minneapolis.

For primary bibliographic entry see Field 5A. W78-04105

TRYING TO EXPLAIN AN EFFECT OF PER SE HYDROSTATIC PRESSURE ON HEART RATE IN FISH, Universite de Bretagne-Occidentale, Brest (France). Lab. of Animal Physiology.

A. Belaud, L. Barthelemy, J. Le Saint, and C. Peyraud.

Aviation, Space, and Environmental Medicine, Vol 47, No 3, March 1976, p 252-257, 3 fig, 2 tab, 12 ref.

Descriptors: *Environmental effects, *Pressure, Water pressure, Hydrostatic pressure, Fish, Temperature, Animal physiology, Heart rate.

A quantitative study was performed to determine the increment of heart rate due to temperature rise resulting from compression. Specific effects of per se pressure were identified as bradycardia above 24.5°C and as tachycardia below this temperature. It was shown that pressure acts through extrinsic mechanisms of heart control and through a direct

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

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action on autonomic cardiac cells. The effect of pressure on cardiac cells is translated according to laws of chemical kinetics. The possibility of an effect of pressure through a direct molecular impact from which reversible structure modifications of some molecule would occur is suggested. (Chilton-ORNL)
W78-04110

RELATION OF WATER TEMPERATURE TO INFECTIONS OF COHO SALMON (ONCORHYNCHUS KISUTCH), CHINOOK SALMON (O. TSHAWYTSCHA), AND STEELHEAD TROUT (SALMO GAIRDNERI) WITH AEROMONAS SALMONICIDA AND A. HYDROPHILA.

Oregon State Univ., Corvallis. Dept. of Microbiology.

W. J. Groberg, Jr., R. H. McCoy, K. S. Pilcher, and J. L. Fryer.

Journal of the Fisheries Research Board of Canada, Vol 35, No 1, January 1978, p 1-7, 1 fig, 6 tab, 6 ref.

Descriptors: Environmental effects, *Water temperature, Fish diseases, Salmonids, Salmon, Chinook salmon, Mortality, Resistance, Water pollution effects, *Coho salmon, *Steelhead trout, *Aeromonas salmonicida, *Aeromonas hydrophila.

Groups of the three salmonid species containing 25 or 35 fish were tested at seven water temperatures from 3.9 to 20.5°C in increments of 2.8°C. Mortalities among the three species of fish infected with *A. salmonicida* ranged from 2 to 26% at 3.9 and 6.7°C. Below temperatures of 6.7°C, the fish survived for 12-23 days. 93-100% of the fish died within 2-3 days at 20.5°C. Investigations using *A. hydrophila* were generally similar to those using *A. salmonicida* except that 64-100% mortality occurred at 20.5°C and no deaths were reported below a temperature of 9.4°C. It was concluded that higher temperatures accelerated the progress of infection by *A. salmonicida* and *A. hydrophila*, while lower temperatures retarded it. (Chilton-ORNL)
W78-04112

SEAWATER ADAPTATION AND PARR-SMOLT TRANSFORMATION OF JUVENILE ATLANTIC SALMON, SALMO SALAR.

Fisheries and Marine Service, Halifax (Nova Scotia). Resource Development Branch.

G. J. Farmer, J. A. Ritter, and D. Ashfield.

Journal of the Fisheries Research Board of Canada, Vol 35, No 1, January 1978, p 93-100, 3 fig, 2 tab, 22 ref.

Descriptors: Environmental effects, *Adaptation, Fish, Salmon, Salinity, *Atlantic salmon, Sea water, Smolt, Growth stages, Juvenile growth stage, *Parr-smolt transformation, Osmoregulatory mechanisms.

Changes in the osmotic concentration of serum, urine and intestinal fluid of Atlantic salmon was investigated as the fish were exposed to salinity increasing from 0.1 to 31%. 1- and 2-yr-old juvenile salmon were exposed to the increasing salinities during February-March as presmots and again during May as smots. Both age-classes adapted equally well and it was concluded that the marine osmoregulatory mechanisms function before completion of parr-smolt transformation. Fish in the parr stage whose fork length exceeded 12-13 cm were able to adapt to increasing salinity. (Chilton-ORNL)
W78-04115

RELATION BETWEEN TEMPERATURE AND INCUBATION TIME FOR EGGS OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA).

Fisheries and Marine Service, Nanaimo (British Columbia). Pacific Biological Station.
D. F. Alderdice, and F. P. J. Velsen.

Journal of the Fisheries Research Board of Canada, Vol 35, No 1, January 1978, p 69-75, 1 fig, 4 tab, 20 ref.

Descriptors: Environmental effects, *Water temperature, *Model studies, *Incubation, Eggs, Hatching, *Chinook salmon, *Salmon eggs.

The objectives of this inquiry were: (1) using available data from the literature and the models (the thermal sums hypothesis, Belehradek's equation and a form of the logistic curve), to select that model best satisfying the rules of minimum variance curve fitting in describing the relation between development time or rate and temperature and (2) using the model selected, to tabulate the resulting rate-temperature relations for chinook eggs. Results using the log-inverse form of Belehradek's equation were found to be better than those from the other models. A table is included of predicted daily rates of development in relation to temperature which may be used to predict hatching time in a manner similar to that employing degree-days. It was concluded that there is a lack of data on development time at temperatures below 5°C. (Chilton-ORNL)
W78-04120

feeding and reproduction. This influence on behavior is apparent at each stage of the life history and is related to the development and transformation of the retinal structure. At the fry stage, the retinal response is one of positive phototaxis which changes to a negative phototactic response before the 2nd yr. of life. Adult walleyes were observed to be active in turbid waters but to rest in contact with the substrate in clear waters. An inverse relationship was noted between number of walleyes sighted and the transparency of the water. The relationship between ambient surface light intensities and feeding rates was studied during open-water period by experimental angling and it was found that the greatest feeding activity occurred at the lower illuminations. (Chilton-ORNL)
W78-04120

ENVIRONMENTAL CONDITIONS OF PERCID WATERS IN CENTRAL EUROPE.

Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.

B. Entz.

Journal of the Fisheries Research Board of Canada, Vol 34, 1977, Part of the Proceedings of the Percid International Symposium convened at Quetico Centre, Ontario, September 24-October 5, 1976. p 1586-1591, 4 tab, 33 ref.

Descriptors: *Environmental effects, *Trophic level, *Mesotrophy, Lakes, Europe, Limnology, Primary production, *Eutrophication, Sediments, Bottom sediments, Water pollution effects, *Percids, Percidae.

The range of environmental conditions of central European lakes in which percids thrive, with emphasis on both abiotic and biotic properties of mesotrophic waters, is defined. Whereas mesotrophic waters on the basis of nutrients fit on a line between oligotrophic and eutrophic waters, certain characteristics point to the existence of optima (calcium content in the sediments as well as the existence of distinct mesotrophic communities of phytoplankton, invertebrates, and fishes) in mesotrophic lakes suggesting a real qualitative difference between mesotrophy on the one hand and eutrophy and oligotrophy on the other. These optima point to the existence of qualitatively different abiotic and biotic conditions in mesotrophic lakes rather than the expected quantitative intermediacy on the oligotrophic-eutrophic cline. (Chilton-ORNL)
W78-04121

LIMNOLOGICAL CHARACTERISTICS OF ONTARIO LAKES IN RELATION TO ASSOCIATIONS OF WALLEYE (STIZOSTEDION VITREUM VITREUM), NORTHERN PIKE (ESOX LUCIUS), LAKE TROUT (SALVELINUS NAMAYCUSH), AND SMALLMOUTH BASS (MICROPTERUS DOLOMIEI),

Canada Centre for Inland Waters, Burlington (Ontario); and Fisheries and Marine Service, Ottawa (Ontario). Great Lakes Biolimnology.

H. Oliver.

Journal of the Fisheries Research Board of Canada, Vol 34, 1977, Part of the Proceedings of the Percid International Symposium convened at Quetico Centre, Ontario, September 24-October 5, 1976. p 1592-1601, 3 fig, 5 tab, 8 ref.

Descriptors: Environmental effects, *Limnology, Lakes, *Walleye, *Trout, *Bass, Fish, *Pikes, *Ontario, *Canada, Distribution, *Percids, Percidae.

This paper attempts to develop an objective classification, by means of limnological characteristics, of the 15 possible associations of four important game fish species in Ontario lakes. Commonest types of the 15 combinations were walleye-pike (22%), pike only (19%), lake trout only (16%), and smallmouth bass only (10%). The variables of greatest significance is distinguishing lake

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types were depth and area. Climatic factors were significant in explaining the general geographic distribution of smallmouth bass. Several hypotheses were advanced to explain the low density of walleye found in small lakes. These included low probability of successful coexistence of pike and walleye, wind conditions in spawning areas, and Lebedraum requirements of walleye. (Chilton-ORNL) W78-04122

TEMPERATURE REQUIREMENTS OF SOME PERCIDS AND ADAPTATIONS TO THE SEASONAL TEMPERATURE CYCLE,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station. For primary bibliographic entry see Field 2H. W78-04124

RESULTS OF AN EXPERIMENTAL FISHERY ON THE CRAYFISH ORCONECTES VIRILIS,
Michigan Dept. of Natural Resources, Lewiston. Hunt Creek Fisheries Research Station. For primary bibliographic entry see Field 2H. W78-04125

CHEMISTRY AND EFFECTS OF CHLORINE IN AQUATIC SYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div. J. S. Mattice, H. A. Pfuderer, and B. N. Collier. Available from the National Technical Information Service, Springfield, VA 22161 as ORNL/EIS-82, Price codes: A04 in paper copy, A01 in microfiche. Report ORNL/EIS-82, March 1976. Environmental Sciences Division Publication No. 808, 149 p. W-7405-eng-26.

Descriptors: Environmental effects, *Water pollution effects, *Bibliographies, Chemistry, *Chlorine, Aquatic environment.

This bibliography contains 191 references relating to the chemistry and effects of chlorine in aquatic systems and is part of an assessment of the literature on the effects of electric generating stations. References are arranged by subject category and indexes are included by author, keywords, scientific names of test organisms, geographic location of field research, and title (alphabetical listing of keywords-in-context). References are abstracted and indexed to reflect the information content of the documents and the interests of the researchers. An effort was made to record chlorine residuals, the systems in which the chlorine was assayed, methods of determination and physical conditions of experiments. All available research papers published prior to 1975 were included. (Chilton-ORNL) W78-04127

ENERGY, WATER AND TRITIUM BUDGETS FOR PERCH LAKE: 1974,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs. E. Robertson, D. P. Wildsmith, and P. C. Jay. Available as AFCL-5380, from Scientific Document Distribution Office, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada, \$2.00. Report AFCL-5380, February 1976. 15 p, 4 fig, 8 tab, 3 ref.

Descriptors: *Environmental effects, *Energy, Tritium, Lakes, Canada, Model studies, *Perch Lake(Ontario).

The work described is a continuation of work done on energy, water and tritium budgets of Perch Lake in the years 1970-73. This paper gives results for 1974 and average values for 1970-74. It was concluded that five years is too short a time to establish statistically significant mean values of components of budget equations but that the 1974 results show little variation from the mean. Instru-

ment failures and poor weather conditions made energy budget estimates of evaporation not possible for each month of each year. It is suggested that the data might prove useful in the development of energy and water budget models. (Chilton-ORNL) W78-04128

DEVELOPMENT OF A UNIFIED TRANSPORT APPROACH FOR THE ASSESSMENT OF POWER-PLANT IMPACT,
Oak Ridge National Lab., TN. Enegy Div. For primary bibliographic entry see Field 5B. W78-04129

A CRITICAL EVALUATION OF THE NON-RADIOLOGICAL ENVIRONMENTAL TECHNICAL SPECIFICATION - VOL. I. PROGRAM DESCRIPTION, SUMMARY AND RECOMMENDATIONS,
Oak Ridge National Lab., TN. Environmental Sciences Div. For primary bibliographic entry see Field 6G. W78-04130

A CRITICAL EVALUATION OF THE NON-RADIOLOGICAL ENVIRONMENTAL TECHNICAL SPECIFICATIONS - VOL. 4, SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1,
Oak Ridge National Lab., TN. Environmental Sciences Div. For primary bibliographic entry see Field 6G. W78-04131

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE KEWAUNEE NUCLEAR POWER PLANT SITE,
Argonne National Lab. IL. I. P. Murarka, J. G. Ferrante, A. J. Pollicastro, and E. W. Daniels. Available from the National Technical Information Service, Springfield, VA 22161 as ANL/EIS-1, Price codes: A11 in paper copy, A01 in microfiche. Report ANL/EIS-1, August 1976. 212 p, 40 fig, 138 tab, 15 ref, 3 append. W-31-109-Eng-38.

Descriptors: *Environmental effects, *Water pollution effects, *Nuclear powerplants, *Monitoring, Thermal pollution, Aquatic environment, Biological communities, Hydrothermal studies, Wisconsin, Data collections, *Lake Michigan, *Keweenaw, Nuclear power plant site(Wisc), Aquatic assessment, Hydrothermal assessment, Plume mapping.

The matters considered in this report are those relating to the monitoring of phytoplankton, zooplankton and benthos in Lake Michigan near the plant site. Studies of the thermal plume measurements and models for making predictions for the Keweenaw Plant are evaluated and the results presented. Analysis of biological data did not show immediate effect on the biota of the lake. Local stimulation of certain phytoplankton groups and subsequent relative enhancement of the Cladocera in the discharge area were noted but no significance could be assigned regarding the effect on lakewide community. Some damage to the benthic community by dredging, the discharge, temperature rise, and velocity were observed. Plume mapping studies were conducted which were considered adequate to define the surface temperatures for higher isotherms under stratified conditions and the complete set of isotherms for unstratified conditions. Plume characteristics showed wide scatter due to different outfall and ambient conditions. (Chilton-ORNL) W78-04132

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR

POWER PLANT SITES - THE QUAD-CITIES NUCLEAR POWER STATION SITE,
Argonne National Lab., IL.

G. J. Marmer, I. P. Murarka, and F. Vaslow. Available from the National Technical Information Service, Springfield, VA 22161 as ANL/EIS-2, Price codes: A04 in paper copy, A01 in microfiche. Report ANL/EIS-2, August 1976, 54 p, 18 fig, 16 tab, 16 ref, 1 append. W-31-109-Eng-38.

Descriptors: *Environmental effects, *Water pollution effects, *Thermal pollution, Powerplants, *Nuclear powerplants, Monitoring, Water quality, Water quality standards, Hydrothermal assessment, Illinois, *Quad-Cities Nuclear Power Plant site(ILL), Data collections.

The Quad-Cities Station began commercial operation in February of 1973. This report presents environmental monitoring data for the period 1972-1975. Hydrothermal assessment and water quality assessment of the monitoring data indicated that no significant immediate deleterious effects or violation of state water quality standards are apparent. Recommendations for improving monitoring techniques are presented. Included in the report is a description of different cooling methods used at the station. (Chilton-ORNL) W78-04133

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE ZION NUCLEAR POWER STATION SITE,

Argonne National Lab., IL. I. P. Murarka, A. Pollicastro, E. Daniels, J. Ferrante, and F. Vaslow. Available from the National Technical Information Service, Springfield, VA 22161 as ANL/EIS-5, Price codes: A17 in paper copy, A01 in microfiche. Report ANL/EIS-5, November 1976. 370 p, 71 fig, 27 tab, 3 append, 36 ref. W-31-109-Eng-38.

Descriptors: *Environmental effects, *Water pollution effects, Powerplants, *Nuclear powerplants, Hydrothermal assessment, Water quality, Water quality standards, Standards, Phytoplankton, Zooplankton, Benthos, Fish, Monitoring, Data collections, Illinois, *Zion Nuclear Power Station site(ILL), *Lake Michigan.

Environmental monitoring data was collected near the Zion Nuclear Power Station during the period 1972-1975. Assessment of hydrothermal data, water chemistry, and aquatic biota indicated that there were no significant immediate deleterious effects from operation of the station. It was concluded, in relation to hydrothermal assessment, that the Pritchard model as developed and used for preoperational predictions failed to include such factors as reentrainment of plume water, recirculation of plume water into the intake, and the effects of stratification and that the model was satisfactory in only about 20% of the cases. The collection of data on distribution of biota followed a grid pattern with emphasis on depth effects. It was recommended that emphasis should be placed on collecting data from multiple station located in the maximum anticipated stress areas. (Chilton-ORNL) W78-04134

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - PRAIRIE ISLAND NUCLEAR GENERATING PLANT SITE,
Argonne National Lab., IL.

I. P. Murarka, J. G. Ferrante, E. W. Daniels, and E. E. Pentecost. Available from the National Technical Information Service, Springfield, VA 22161 as ANL/EIS-6, Price codes: A06 in paper copy, A01 in microfiche. Report ANL/EIS-6, November 1976, 106 p, 47 fig, 11 tab, 5 ref, 3 append. W-31-109-Eng-38.

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

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Descriptors: *Environmental effects, *Water pollution effects, *Thermal pollution, Powerplants, *Nuclear power plants, Phytoplankton, Zooplankton, Benthos, Monitoring, Standards, Aquatic environment, Terrestrial habitats, Data collections, Minnesota, Prairie Island Nuclear Generating Plant site(Minn).

Environmental monitoring data collected near the Prairie Island Nuclear Generating Station during the period 1973-1975 was assessed. It was concluded that population densities vary from one year to the next and that several years of data are needed to adequately assess or detect trends in terrestrial systems. No immediate significant deleterious effects on the biota of the area from plant operation were detected. The effect of plant operation could not be distinguished from naturally occurring variability for the phytoplankton, zooplankton, and benthos groups of organisms. (Chilton-ORNL)
W78-04135

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - A SYNTHESIS AND SUMMARY WITH RECOMMENDATIONS,

Argonne National Lab., IL.
L.P. Murarka, A. J. Pollicastro, J. G. Ferrante, E. W. Daniels, and C. J. Marmer.
Available from the National Technical Information Service, Springfield, VA 22161 as ANL/EIS-8, Price codes: A03 in paper copy, A01 in microfiche. Report ANL/EIS-8, November 1976, 23 p, 2 fig, 2 tab. W-31-109-Eng-38.

Descriptors: *Environmental effects, *Monitoring, Powerplants, *Nuclear powerplants, Hydrothermal assessment, Water quality, *Water quality standards, Aquatic environments, Terrestrial habitats, Statistical methods, *Sites, *Data collection, *Water pollution effects.

Field data collected during a monitoring program at seven nuclear power plant sites was analyzed and indicated that the plants had no significant ecological impacts. It was concluded that revisions need to be made in monitoring schemes in order that more precise conclusions could be drawn from fewer field measurements and in order that the data might be suited for modern statistical procedures. (Chilton-ORNL)
W78-04136

RESIDUAL TOXICITY OF SEVERAL DISINFECTANTS IN DOMESTIC WASTEWATER,

Grand Valley State College, Allendale, MI.
R. W. Ward, and G. M. DeGraeve.

Journal Water Pollution Control Federation, Vol. 50, No. 1, January 1978, p 46-60, 13 tab, 18 ref.

Descriptors: *Environmental effects, *Water pollution effects, Effluents, Waste water(Pollution), Wastes, Water pollution sources, *Chlorine, *Bromine, *Ozone, Fish, Mortality, Growth rates, Reproduction, *Toxicity, *Disinfection, Fathead minnows, *Pimephales promelas*.

This life cycle study with fathead minnows was designed to test the toxicity of a nondisinfected effluent stream and the residual toxicity of identical effluent streams disinfected with chlorine, bromine chloride, or ozone, as well as a chlorinated stream dechlorinated with sulfur dioxide. Results showed that mean total residual chlorine concentrations as low as 0.045 mg/l in secondary effluent have the potential to negatively affect the survival of fathead minnows and levels as low as 0.033 mg/l can retard their growth. Adverse effects of residual chlorine on survival and growth can be eliminated with no undesirable side effects by dechlorination with sulfur dioxide. Mean residual bromine chloride concentrations as low as 0.034 mg/l inhibited growth of the minnows. Long-term exposure to ozonated effluent with mean residual ozone levels of 0.016 mg/l did not

affect survival, growth or reproduction of fathead minnows. (Chilton-ORNL)
W78-04138

FEEDING ECOLOGY OF THE BLUEGILL, LEPOMIS MACROCHIRUS, IN TWO HEATED RESERVOIRS OF TEXAS, III. TIME OF DAY AND PATTERNS OF FEEDING,
Bangladesh Agricultural Univ., Mymensingh. Faculty of Fisheries.
For primary bibliographic entry see Field 2H.
W78-04139

ON THE DYNAMICS OF EXPLOITED POPULATIONS OF TISBE HOLOTHURIAE (COPEPOD, HARPACTICOIDAE), IV. THE TOXICITY OF CADMIUM: RESPONSE TO LETHAL EXPOSURE,
Biologische Anstalt Helgoland (West Germany). M. Hoppenheit, and K.-R. Sperling.
Helgolander Wissenschaftliche Meeresuntersuchungen, Vol 29, p 328-336, 1977. 17 ref, 7 fig, 1 tab.

Descriptors: *Copepods, *Invertebrates, Exploitation, *Cadmium, *Toxicity, *Mortality, Population, *Lethal limit, Water pollution effects, Metals, Crustaceans, Reproduction, Laboratory tests, Zooplankton, Fish food, Tisbe, Harpacticoid copepods.

A total of 90, weekly exploited populations of the harpacticoid copepod *Tisbe holothuriae* were exposed to cadmium concentrations ranging from 148 to 1125 microgr/l, combined with exploitation rates from 10 to 90% under conditions of surplus food supply. All populations exposed to concentrations down to 500 microgr/l Cd and 3 populations (out of 15) exposed to 333 microgr/l Cd became extinct within the experimental period of 32 weeks. Survival time depended on concentration. A recovery phase from an initially high mortality preceded eventual population extinction after adding 500 microgr/l Cd. In the initial phase, higher nauplii mortality prevailed. Experiments on the effects of stepwise increases in Cd concentration produced evidence that a relationship between survival and exploitation rate exists. In spite of increased mortality, no significant numbers of dead copepods were detected in weekly samples because of their rapid decomposition and cannibalism, which depends on the amount of food available. (Katz)
W78-04140

THE EFFECTS OF POLLUTION BY SEWAGE ON THE TOTAL, NITROGEN, PROTEIN AND AMINO ACIDS OF THE MARINE PHANEROGRAM CYMODOCEA NODOSA (INFLUENCE DE LA POLLUTION PAR LES EAUX D'EGOUTS SUR LA COMPOSITION EN AZOTE TOTAL, EN PROTEINES ET EN ACIDES AMINES DE LA PHANEROGAME MARINE CYMODOCEA NODOSA),
Centre Univ. de Luminy, Marseille (France). Lab. de Biologie Végétale Marine.

H. M. Augier, M. Santimone, and M. Vincentelli. Environmental Pollution, Vol. 13, p 217-227, 1977. 4 fig, 1 tab, 12 ref. (In French with English abstract).

Descriptors: *Aquatic plants, *Proteins, *Biochemistry, *Nitrogen, *Chemical analysis, *Amino acids, Metabolism, Environmental effects, *Water pollution effects, Bioassay, Growth rates, Plant morphology, Plant physiology, Rhizomes, Root systems, Plant growth, Cytological studies, *Cymodocea nodosa*, *Marine phanerogam.

The amounts of total nitrogen, proteins and amino acids in the marine phanerogram *Cymodocea nodosa* were obtained through chromatography on an ion exchanger with an apparatus for automatic dosage. The experiments established that pollution

was a factor of nitrogen enrichment in *Cymodocea*, since, in polluted media, plants showed higher rates of synthesis of nitrogen and protein than in non-polluted media. A comparative study of the different parts showed this increase in the total nitrogen and protein synthesis rates in polluted media to be more accentuated in the rhizomes and roots than in the leaves. This phenomenon also occurred with the amino acids but with specific variations in the leaves, rhizome and roots. The results obtained may permit a criterion to be established for the quality of marine waters. (Klein)
W78-04141

ACTION OF SUBLETHAL DOSES OF HEAVY METALS ON THE GROWTH CHARACTERISTICS OF THE DIATOM SKELETONEMA COSTATUM, (ACTION DE METAUX LOURDS A DES DOSES SUBLETALES SUR LES CARACTERISTIQUES DE LA CROISSANCE CHEZ LA DIATOMEE SKELETONEMA COSTATUM),
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.

B. R. Berland, D. J. Bonin, O. J. Guerin-Ancey, V. I. Kankov, and D. P. Arthac. Marine Biology, Vol. 42, p 17-30, 1977. 6 fig, 3 tab, 35 ref.

Descriptors: *Heavy metals, *Mercury, *Cadmium, *Copper, *Diatoms, *Growth rates, *Growth stages, Environmental effects, Path of pollutants, Microorganisms, Toxicity, Algae, Cytological studies, Metabolism, Phytoplankton, Lethal limit, Skeletonema, Sublethal effects, Sublethal doses, Teratology.

Sublethal effects of mercury, cadmium, and copper on the diatom *Skeletonema costatum* (Grev.) Cleve, grown in batch and bacteria-free culture was studied. Division rate, maximum yield growth, mean cell volume, particulate carbon and nitrogen, and 14C-bicarbonate uptake was used as toxic impairment criteria. Division rate was the first-affected and most sensitive parameter, but algal responses vary according to the metal. Hg produces an acute decrease in division rate, followed by a temporary recovery of growth capacity within the first 48 h after metal addition. Cd, on the other hand, increases division rate, followed by an obvious decrease. Cu reduces division rate slowly or quickly, depending on the metal concentration. Cell synthesis capacity (cultural biovolume, particulate carbon and nitrogen, carbon assimilation) was less affected than division rate, especially with Hg. The C:N cell ratio was unchanged at sublethal concentrations, even when production was reduced. The mean cell volume was slightly affected: the variations were not greater than those of the control during its growth phases. Markedly teratological forms were never observed. In the author's opinion, these results confirm that many parameters and growth kinetic aspects must be considered to fully appreciate the effects of sublethal concentrations of heavy metals. (Katz)
W78-04142

COMPARATIVE STUDY OF THE PLUTONIUM LEVELS IN VARIOUS MOLLUSCS FROM SEVERAL FRENCH LITTORAL SITES, (ETUDE COMPARÉE DES TENEURS EN PLUTONIUM CHEZ DIVERS MOLLUSQUES DE QUELQUES SITES LITTORAUX FRANÇAIS),
CEA Centre de l' Hague, Cherbourg (France). Lab. de Radioecologie Marine.

J. C. Guary, and A. Fraizer. Marine Biology, Vol. 41, p 263-267, 1977. 1 fig, 1 tab, 16 ref.

Descriptors: *Metals, *Mollusks, *Invertebrates, *Animal physiology, *Path of pollutants, *Absorption, *Distribution patterns, Sampling, Water pollution sources, Nuclear wastes, Bioaccumulation, Tissue analysis, *Plutonium, France.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

Plutonium contents of various species of molluscs sampled from several sites along the French coast were measured in order to reveal any distributional patterns of the plutonium levels. The influence of the La Hague nuclear fuel reprocessing plant was apparent in the immediate proximity of the waste-disposal outfall (Ecalgrain Bay), and to a lesser degree in an oyster farming center situated about 50 km east of the Bay of Ecalgrain (St. Vaast-la-Hougue). Plutonium concentrations in molluscs from the remaining sites were quite comparable to levels that have been measured in similar species subject only to plutonium derived from atmospheric fallout. All molluscs, except those from Ecalgrain Bay, displayed higher levels of plutonium in the shell than in the soft parts, a finding in agreement with similar studies which have been reported recently. However, those individuals sampled from the vicinity of the outfall consistently displayed shell:soft parts plutonium ratios of less than 1. This difference may reflect different physico-chemical forms of this isotope present at the different sampling stations. With the exception of *Crepidula fornicate* shell, the tissues of filter-feeding molluscs do not appear to concentrate plutonium above the level found in other types of molluscs. (Klein) W78-04143

ON MERCURY AND SELENIUM CONTAINED IN TUNA FISH TISSUES-IV. METHYL MERCURY LEVEL IN MUSCLES AND LIVER OF YELLOWFIN TUNA, (IN JAPANESE), Shimonoseki Univ. of Fisheries, (Japan). Dept. of Food Science and Technology.

For primary bibliographic entry see Field 5A. W78-04144

PALAOECOLOGICAL STUDIES OF THE RECENT DEVELOPMENT OF LAKE VAXJOSJON II. SETTLEMENT AND LANDSCAPE DEVELOPMENT,

Kvartarbiologiska Labs, Lund (Sweden).

G. Digerfeldt.

Archiv für Hydrobiologie, Vol. 79, No. 4, p 465-477, 1977. 3 fig, 9 ref.

Descriptors: *Human population, *Urbanization, *Lake Vaxjosjon(Sweden), *Palaeoecology, Drainage patterns, Lake stages, Paleolimnology, History, Land use.

An attempt is made to reconstruct human influence on the landscape around Lake Vaxjosjon, Sweden, from about 600 AD until present times. Exploitation of the landscape for settlement and livelihood has affected the existing vegetation and soils and knowledge of the landscape development is important for a correct interpretation of the lake development. Interpretation of development of the regional vegetation is based on pollen analysis; description of the settlement development pattern is based on available archaeological information. About 600 AD there was a distinct expansion of the settlement in the region. Since then it is likely that human interference became a progressively greater influence on the surrounding landscape and the lake. The thrust of the study is to return to a time when the lake was mainly uninfluenced by human activity, so that effects of the recent pollution can be assessed in relation to the preceding natural lake development. (Coyle-Wisconsin) W78-04152

REPORT OF A WORKSHOP ON THE IMPACT OF THERMAL POWER PLANT COOLING SYSTEMS ON AQUATIC ENVIRONMENTS. Sigma Research Inc., Richland, WA.

Available from the National Technical Information Service, Springfield, VA 22161 as CONF-750 980-2, Price codes: A02 in paper copy, A01 in microfiche. CONF-750 980, Report EPRI SR-38 of a Workshop held in Asilomar, Pacific Grove, California, September 28-October 2, 1975, Vol 2. Technical and Topical Papers. Prepared for Elec-

tric Power Research Institute, Palo Alto, California. 234 p.

Descriptors: *Environmental effects, *Water pollution effects, *Thermal pollution, Powerplants, *Cooling water, Aquatic environments, Conferences, Reviews, Heated water.

Vol. 1 (See W77-11123) of this series contains the deliberations of the workshop and a number of high priority research recommendations resulting from the deliberations. Vol. 2 contains 22 technical and topical papers which deal with the problems of power plant impact on aquatic systems from social, technological, and cost-benefit points of view as well as covering a broad spectrum of research interests. These interests include ecological design parameters for assessing impact; recovery of perturbed systems; site-specific studies; thermal physiological effects; fish behavior; hydrothermal modeling; entrainment, entrapment, impingement effects; water chlorination; thermoregulation in fish; radionuclides in aquatic ecosystems; aquatic monitoring; and thermal plume prediction. (See W78-04156 thru W78-04173) (Chilton-ORNL) W78-04155

TECHNOLOGY OF POWER PLANT COOLING, Electric Power Research Inst., Palo Alto, CA. Fossil Fuel and Advanced Systems Dept.

J. S. Maulbetsch, and R. W. Zeren. CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975, Vol 2. Technical and Topical Papers. p 21-37, 1 fig, 3 tab.

Descriptors: Environmental effects, *Water pollution, *Cooling water, Powerplants, *Thermal pollution, Evaluation, Technology, Reviews.

This paper provides an overview of the technological problems involved in power plant cooling systems and their impact on aquatic environments. Discussion centers around a definition of the need for cooling water; technical, economic, and legislative constraints within which the cooling problem must be solved; alternate cooling methods available under development; water treatment requirements; and alternatives for modifying the physical impact on aquatic systems. It is recommended that the workshop should strive to identify ecological impacts of waste heat discharges to aquatic ecosystems, the shortcomings in current knowledge and research programs that should be undertaken to correct the shortcomings. (See also W78-04155) (Chilton-ORNL) W78-04156

PROBLEMS IN DETERMINING THE IMPACT OF POWER PLANTS ON LARGE FRESHWATER SYSTEMS, Wisconsin Univ., Milwaukee. Center of Great Lakes Studies.

A. M. Beeton.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975. Vol 2. Technical and Topical Papers. p 56-72, 11 fig, 2 tab.

Descriptors: *Environmental effects, *Water pollution effects, *Powerplants, Freshwater, Aquatic environments, Discharge(Water), Water quality, Oak Creek powerplant(Wisconsin).

The study reported upon was undertaken to evaluate the effect of the discharge from Oak Creek power plant on aquatic systems. Surveys showed that quality of near shore water was determined by discharge on water quality could be detected. A greater abundance of some plankters inshore was apparently the usual situation and the result of

greater nutrient concentrations. The only direct effect of the power plant appeared to be the stimulation of primary production of algae which had passed through the plant and this effect was not of such a magnitude as to be detected by near plant surveys of nutrients and chlorophyll. (See also W78-04155) (Chilton-ORNL) W78-04157

POWER PRODUCTION ON ESTUARIES AND TIDAL RIVERS.

Virginia Electric and Power Co., Richmond.

M. L. Brehmer.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California September 28-October 2, 1975, Vol 2. Technical and Topical Papers. p 73-77.

Descriptors: *Environmental effects, Powerplants, *Estuaries, *Tidal waters, *Chesapeake Bay, *Power production.

The paper discusses the potential environmental impact of electrical generating facilities on tidal waters particularly as found on the Chesapeake Bay system. It was concluded that there are environmental costs involved but that on the Chesapeake Bay these are within acceptable limits. A high level of confidence is expressed that power station operation will not adversely affect either the composition or population of phytoplankton or zooplankton outside the 5C isotherm. An attempt is made to point out areas in need of additional research. (See also W78-04155) (Chilton-ORNL) W78-04158

ECOLOGICAL DESIGN PARAMETERS FOR ASSESSING THE IMPACT OF HEATED WASTE WATER DISCHARGES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

J. Cairns, Jr., and K. L. Dickson.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975, Vol 2. Technical and Topical Papers. p 78-84, 15 ref.

Descriptors: *Environmental effects, *Powerplants, Sites, *Water pollution, *Thermal pollution, Thermal stress, Waste water(Pollution), Effluents, Ecosystems, Evaluation.

In view of the fact that ecosystems vary in their ability to resist perturbations caused by waste discharges and other stresses, extensive surveys are necessary for precise estimates of environments impact of individual sites. This paper discusses factors which can be useful in making preliminary estimates of sites. The paper suggests that preliminary site evaluations should include the determination of the ability of the ecosystem to resist pollution stress; determination of the ability of the system to recover from pollution displacement; an ecological baseline survey and evaluation of heated discharges on community structure; and evaluations of the temperature requirements of important aquatic species. (See also W78-04155) (Chilton-ORNL) W78-04159

ON THE RECOVERY OF PERTURBED ECOSYSTEMS,

California Univ., Santa Barbara. Dept. of Biological Sciences.

J. H. Connell.

CONF-750980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975, Vol 2. Technical and Topical Papers. p 85-91, 1 fig, 8 ref.

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Descriptors: *Environmental effects, *Ecosystems, Population, Management, Model studies, Stability, Forest ecosystem, Recovery (Perturbed ecosystems).

Various theories concerning the mechanisms involved in the process of species composition recovery of an ecosystem following different scales of perturbation are discussed in some detail. A forest ecosystem is used as an example and it is pointed out that the principles are applicable to aquatic systems as well. Implications of the various theories for population dynamics and ecosystem management are presented. (See also W78-04155) (Chilton-ORNL) W78-04160

THE NEED TO ASSESS COOLING WATER USE ON A WATER BODY BASIS,

Great Lakes Fishery Commission, Ann Arbor, MI. C. M. Fetterolf, Jr.

CONF-750980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Silomar, Pacific Grove, California, September 28-October 2, 1975, Vol. 2. Technical and Topical Papers. p 92-100, 6 ref.

Descriptors: Environmental effects, *Water pollution, *Cooling water, Powerplants, Ecosystems, Biological communities, Management, Water allocation (Policy), Protection, *Thermal pollution, Allocation, Biological value, Species composition, Representative species.

The author presents a concept identified as biological value allocation. It is suggested that this concept involves individuals or groups whose activity is related to the environment accepting responsibility to the environment, to those making use of the environment and to the people. Some of the major basic components of the mechanism related to this concept are agreement on uses to be protected, identification of important species, selection of species representative of the ecosystem, biological mapping of the waterbody, assignment of numerical biological value to zones on basis of importance of ecosystem function, identification of loss levels in each zone as well as total waterbody, selection of protection level, calculation of biological value available for allocation, and allocation to present dischargers and reservation for future dischargers. (See also W78-04155) (Chilton-ORNL) W78-04161

THERMAL PHYSIOLOGICAL EFFECTS IN AQUATIC SYSTEMS,

Toronto Univ., (Ontario). Inst. for Environmental Studies. E. E. J. Fry.

CONF-750980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Silomar, Pacific Grove, California, September 28-October 2, 1975, Vol. 2. Technical and Topical Papers. p 101-117, 7 fig, 28 ref.

Descriptors: *Environmental effects, *Water pollution, *Thermal pollution, *Thermal stress, *Aquatic environment, Temperature, Mortality, Physiological ecology, *Ecology.

The present paper was prepared to bring attention to thermo-physiological findings which have surfaced since the publication of Water Quality Criteria, 1972. It is stated that temperature not only limits the range for existence, but that it also governs the capacity to be active within that range. Examples of these restrictions imposed by temperature are presented for various organisms. In addition to the direct effects of temperature on existence and activity and the direct regulatory response or thermokinesis, indirect effects such as the interaction between temperature and the toxic effects of deleterious materials are discussed. (See also W78-04155) (Chilton-ORNL)

W78-04162

THE REACTION OF SMALL FISH TO PERFORATED PLATES,

California Univ., Berkeley. Dept. of Hydraulic Engineering. For primary bibliographic entry see Field 81. W78-04163

HYDROTHERMAL MODELING, Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering; and Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics. For primary bibliographic entry see Field 5B. W78-04164

EFFECTS OF ENTRAPMENT, ENTRAPMENT AND IMPINGEMENT,

Ecological Analysts, Inc., Baltimore, MD. For primary bibliographic entry see Field 81. W78-04165

MECHANISMS OF BEHAVIORAL THERMOREGULATION IN FISHES,

Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences. W. H. Neil.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Silomar, Pacific Grove, California, September 28-October 2, 1975, Vol. 2. Technical and Topical Papers. p 156-169, 3 fig, 18 ref.

Descriptors: *Environmental effects, *Water pollution, *Thermal pollution, Powerplants, Cooling water, *Fish behavior, Temperature, *Thermoregulation (Fish behavior).

Two concepts of fish behavior, predictive behavioral thermoregulation and reactive behavioral thermoregulation, are discussed. It was concluded that fish distribution in nature could not be predicted on the basis of fishes' environmental tolerance and preferences alone, but that predictively and reactively thermoregulating fish will distribute themselves very differently in a given environment, even though the two types of fish are identical in other respects including temperature preference. It was also suggested that fish distributions are strongly persistent despite temporal changes in thermal structure of the environment. (See also W78-04155) (Chilton-ORNL) W78-04166

RADIONUCLIDES IN AQUATIC ECOSYSTEMS ASSOCIATED WITH POWER PLANTS,

Northeast Utilities Service Co., Hartford, CT. Environmental Program Branch. For primary bibliographic entry see Field 5B. W78-04167

PROBLEMS ASSOCIATED WITH AQUATIC MONITORING AND RESEARCH AT OPERATING POWER STATIONS,

Consumers Power Co., Jackson, MI. Environmental Planning. For primary bibliographic entry see Field 5B. W78-04168

THE EFFECTS OF POWER PLANTS ON FISH POPULATIONS,

Rhode Island Univ., Kingston. Dept. of Oceanography. S. B. Sails.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Silomar, Pacific Grove, California, September 28-October 2, 1975, Vol. 2. Technical and Topical Papers. p 182-186, 7 ref.

Descriptors: *Environmental effects, *Powerplants, Nuclear powerplants, *Fish populations, Thermal stress, Entrainment, Life history studies, Mortality, Stock identification.

The paper reviews several aspects of electrical production by nuclear power plants and suggests that, contrary to general opinion, thermal pollution does not appear to be the leading adverse environmental treat from power plants but that the more critical problem is entrainment. It is suggested that two major aspects of fish population dynamics which have not received adequate attention in power plant related fishery studies are stock identification and early life history mortality estimation. (See also W78-04155) (Chilton-ORNL) W78-04169

WHAT CAN WE LEARN FROM THERMAL PLUME PREDICTION,

Corvallis Environmental Research Lab., OR. For primary bibliographic entry see Field 5B. W78-04170

INVESTIGATIONS INTO MINIMIZING FISH LOSS AT STEAM ELECTRIC GENERATING STATIONS,

Southern California Edison Co., Rosemead. For primary bibliographic entry see Field 81. W78-04171

AQUATIC LIFE IN TEXAS RESERVOIRS,

Texas Electric Service Co., Fort Worth. J. E. Tilton.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Silomar, Pacific Grove, California, September 28-October 2, 1975, Vol. 2. Technical and Topical Papers. p 219-228, 1 fig, 1 tab.

Descriptors: *Environmental effects, *Water pollution, *Thermal pollution, Powerplants, Cooling water, Fish, Phytoplankton, Zooplankton, Benthos, Populations, Reservoirs, *Texas.

Studies of reservoirs used for cooling water supplies for steam-electric generating stations are reviewed. These studies include a reservoir with a thermal discharge for 50 years, several with heat release and daily chlorination for longer than 20 years and many with 5 to 20 years of power plant operation. Data from these studies indicate that the thermal effluents do not affect the phytoplankton, zooplankton, benthos or fish population in a detrimental manner. Total fish and game fish productivity in 20 reservoirs is tabulated. (See also W78-04155) (Chilton-ORNL) W78-04172

POWER PLANT CHLORINATION: REGULATORY CONSIDERATIONS,

Michigan Water Resources Commission, East Lansing. J. G. Truchan.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Silomar, Pacific Grove, California, September 28-October 2, 1975, Vol. 2. Technical and Topical Papers. p 229-234, 5 ref.

Descriptors: *Environmental effects, *Water pollution, *Chlorination, Water quality, Water quality standards, Standards, Permits, National Pollutant Discharge Elimination System.

Chlorine limitations imposed in National Pollutant Discharge Elimination System permits in Minnesota, Michigan, Wisconsin, Ohio, Indiana and Illinois are discussed. The technical and legal basis for restrictive limitations have been challenged by utilities throughout the region for the following reasons: regulations limit free-residual not total-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

residual chlorine and limits on materials other than those in guidelines cannot be applied; higher concentrations of chlorine are allowed in municipal wastewater treatment plant permits; plants cannot operate at these reduced concentrations due to condenser fouling; too many units to chlorinate individually in two hours total application time/day; titration method is too complicated and expensive; lack of available, reliable, automatic control technology; biological data base not sufficient to justify concentrations; limits not needed to protect fish because discharge water velocity prevents their entering discharge areas and water quality too low for their presence. (See also W78-04155) (Chilton-ORNL) W78-04173

THE CONNECTICUT RIVER ECOLOGICAL STUDY, THE IMPACT OF A NUCLEAR POWER PLANT.

American Fisheries Society, Bethesda, MD. Available from the American Fisheries Society, Bethesda, Maryland, 20014. Monograph No. 1, 1976, Merriman, D. and Thorpe, L. M. (eds.) 252 p. Append.

Descriptors: *Environmental effects, *Water pollution, *Thermal pollution, Effluents, Ecology, Reviews, Hydrography, Chemistry, Benthos, Plankton, Fish, *Connecticut River, *Nuclear power plants.

This monograph presents a detailed description of the results of an ecological study, 1965-1973, of the effects of the warm-water effluent from the Connecticut Yankee Atomic Power Company's electric generating plant at Haddam Neck on the lower reaches of the Connecticut River. The study, which embodies hydrography, the benthos, and the resident and anadromous fishes, is characterized by the fact that it was begun while the plant was still in the early stages of construction and the field work was only terminated six years after the inception of commercial operation. The monograph contains nine papers dealing with the areas of hydrography and chemistry, benthic fauna, entrainment of zooplankton, fishes of the lower Connecticut River, ichthyoplankton and entrainment, juvenile shad, adult shad and fish kills. One section carries summary and conclusions of the study. (See also W78-04183) (Chilton-ORNL) W78-04174

OXYGEN BALANCE IN THE CONDENSER-COOLING WATER SYSTEM OF THE CONNECTICUT YANKEE PLANT,

Essex Marine Lab., CT.

P. M. Jacobson.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No. 1, 1976, Merriman, D., and Thorpe, L. M., (Eds.) p 35-38, 3 tab, 11 ref.

Descriptors: Environmental effects, *Water pollution, *Thermal pollution, *Cooling water, Powerplants, *Nuclear powerplants, *Oxygen balance, Dissolved oxygen, Condensers, *Connecticut River.

This study of oxygen balance in the condenser-cooling water system was undertaken to determine the extent and nature of any changes in dissolved oxygen concentrations that might occur in the water during its passage through the plant and down the canal to its discharge. Measurements were made at the point of intake of the system, the outfall from the plant above the weir, and near the top and bottom of the effluent canal. Estimates were also made of the production and consumption of oxygen by the plants and animals in the canal. It was concluded that plant operation has no meaningful effect on dissolved oxygen levels in the heated water discharged to the river. (See also W78-04174) (Chilton-ORNL) W78-04175

RECURRENT MASS MORTALITIES OF THE BLUEBACK HERRING, *ALOSA AESTIVALIS*, IN THE LOWER CONNECTICUT RIVER,

Essex Marine Lab., CT.
S. A. Moss, W. C. Leggett, and W. A. Boyd.
In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No. 1, 1976. Merriman, D., and Thorpe, L. M., (eds.) p 227-234, 4 fig, 2 tab, 9 ref.

Descriptors: *Environmental effects, Powerplants, Nuclear powerplants, *Thermal pollution, Mortalities, Dissolved oxygen, Temperature, Spawning, *Herrings, *Connecticut River, Fish-kill, Spawning run, Blueback herrings.

Five mass mortalities of blueback herring occurred in the lower 48 km of the Connecticut River in the latter part of June and/or the first half of July in 1965, 1966, 1967, and 1971. The mortalities occurred in the early morning when dissolved oxygen fell in the ranges below 1.3 mg/l at 24.6C and 3.6 mg/l at 27.6C. Only one of these mortalities occurred in years in which the plant was in operation. (See also W78-04174) (Chilton-ORNL) W78-04176

THE AMERICAN SHAD (*ALOSA SAPIDISSIMA*), WITH SPECIAL REFERENCE TO ITS MIGRATION AND POPULATION DYNAMICS IN THE CONNECTICUT RIVER,

Essex Marine Lab., CT.

W. C. Leggett.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No. 1, 1976, Merriman, D., and Thorpe, L. M., (eds.) p 169-225, 27 fig, 40 tab, 91 ref.

Descriptors: *Environmental effects, Powerplants, *Nuclear powerplants, Water pollution, Thermal pollution, *Fish migration, *Migration patterns, *Connecticut River, *American shad.

The geographical range, relationship of shad to other members of genus *Alosa*, and their life history are reviewed. 34,000 adult shad were tagged with darts in the lower Connecticut River. Over 20% of the tags were returned with full data on the time and place of recapture. An additional 239 shad were fitted with ultrasonic tags and were tracked continuously for several days. Data showed that no thermal block to the upriver passage of shad exists as a result of the plant operation. Population trends of shad in the Connecticut River over the past three decades are presented. (See also W78-04174) (Chilton-ORNL) W78-04177

BENTHIC FAUNA: 1965-1967 VERSUS 1968-1972,

Essex Marine Lab., CT.

R. R. Massengill.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No. 1, 1976, Merriman, D., and Thorpe, L. M. (eds.) p 39-53, 3 fig, 5 tab, 8 ref.

Descriptors: *Environmental effects, *Water pollution, *Thermal pollution, Powerplants, *Nuclear powerplants, *Benthos, Populations, Invertebrates, Discharge(Water), Effluents, *Connecticut River, *Benthic fauna.

This study was made to assess changes in benthic invertebrate populations in the vicinity of the Connecticut Yankee plant. More than 4,700 samples and 550,000 organisms involving 72 species were collected. Four general benthic biotopes, each possessing distinctive biological characteristics, were found in the vicinity (gravel, rock, sand, and silt). Rocky areas extended along the shore opposite the plant and heated water sometimes reached these areas but no biological changes were

noted. High current velocities at the water intake depopulated invertebrates from the substratum when the plant went into operation. Heat did not reach the bottom and the bottom was repopulated during intervals of shutdown. In sediments near the discharge, diversity indices reflected an increase in number of species, but a reduction in number of individuals, as operation of the plant continued. The sand substratum became overlain by silt and the kinds and numbers of species decreased. Approximately 2.2 million organisms was the estimated population decrease from the area in direct contact with the plume. At stations not affected by the plume, the number of species and individuals increased continuously throughout the study. (See also W78-04174) (Chilton-ORNL) W78-04178

ENTRAINMENT OF ZOOPLANKTON AT THE CONNECTICUT YANKEE PLANT,

Essex Marine Lab., CT.

R. R. Massengill.

In: The Connecticut River Ecological Study; The Impact of a Nuclear Power Plant, American Fisheries Monograph No. 1, 1976, Merriman, D., and Thorpe, L. M., (eds.) p 55-59, 4 tab, 11 ref.

Descriptors: *Environmental effects, *Water pollution, Thermal pollution, Powerplants, Nuclear powerplants, *Entrainment, Plankton, Zooplankton, Mortality, Temperature, *Connecticut River.

Zooplankton in the river, (dominated by entomopelagic crustacea) were generally more abundant in the region of the channel and showed a strong diurnal trend in vertical distribution. Of the zooplankton in the vicinity of the plant, the numbers entrained at the intake averaged about 4%. Mortalities of cladocerans and cyclopoid copepods (the dominant forms in warmer months) attributable to mechanical damage in passing through the condenser-cooling system were negligible. Mortalities of these organisms due to heat were essentially 100% when temperatures were above 31C, a period of about 120 days a year; but during cooler periods most of the population appeared to survive. (See also W78-04174) (Chilton-ORNL) W78-04179

EARLY LIFE HISTORY STUDIES OF AMERICAN SHAD IN THE LOWER CONNECTICUT RIVER AND THE EFFECTS OF THE CONNECTICUT YANKEE PLANT,

NUS Corp., Pittsburgh, PA. Ecological Sciences Div.

B. C. Marcy.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No. 1, 1976, Merriman, D., and Thorpe, L. M., (eds.) p 141-168, 14 tab, 9 fig, 164 ref.

Descriptors: *Environmental effects, *Water pollution, Powerplants, *Nuclear powerplants, Life history studies, Eggs, Larvae, Juveniles, *Connecticut River, *American shad.

All stages of the life history of the American shad were investigated to determine possible adverse effects of the power plant. These studies were primarily concerned with the distribution and abundance of eggs and young shad and with downstream migration. Eggs were stripped from ripe fish and reared in the laboratory to determine development rate. A developmental timetable was established to make possible the aging of eggs collected in the river. Calculations indicated that most eggs travelled only 1.6 to 6.4 km from the point of spawning. It was suggested that differences in time and place of spawning that eggs of shad in the lower Connecticut River ranked eighth in abundance and larvae ranked twelfth. When estimates of natural mortality are taken into consideration in relation to the estimated number of

shad would be concluded. (See also W78-04178)

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Effects Of Pollution—Group 5C

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shad would have been lost in entrainment, it was concluded that only approximately one adult shad would have been lost by this means in 1968 and 1969. No evidence was obtained to indicate that the plant exerted any harmful effects on the occurrence, distribution, and abundance of juvenile shad. (See also W78-04174) (Chilton-ORNL)

W78-04180

PLANKTONIC FISH EGGS AND LARVAE OF THE LOWER CONNECTICUT RIVER AND THE EFFECTS OF THE CONNECTICUT YANKEE PLANT INCLUDING ENTRAINMENT, NUS Corp., Pittsburgh, PA. Ecological Sciences Div.

B. C. Marcy.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No 1, 1976, Merriman, D., and Thorpe, L. M., (eds.) p 115-139, 20 tab, 3 fig, 164 ref.

Descriptors: *Environmental effects, *Water pollution, *Entrainment, Thermal pollution, *Fish eggs, *Larvae, *Plankton, Temperature, Mortality, *Connecticut River, Mechanical damage.

Eggs and larvae representing 16 species of fish were collected in 690 biweekly plankton tows at 16 sampling stations. Alewife, blueback herring, white perch and yellow perch made up 98% of the total egg production. 77% of the egg production occurred above the plant with the number of eggs collected near the intake representing only 0.2% of production. For this reason, the potential effect of entrainment on fish eggs at the intake appeared to be minimal. Data showed that all fish larvae and early juveniles of nine fish species that passed through the plant were dead by the time they reached the end of the discharge canal. Sampling during June and July, when 95% of the non-screenable fish were present near the intake, showed at approximately 80% of the total mortality in the canal had been caused by mechanical damage and 20% by heat shock. It was concluded that any estimate of the effect of mortality from entrainment on the total fish population must take into account the natural mortality that occurs during specific life stages of each species. (See also W78-04174) (Chilton-ORNL)

W78-04181

FISHES OF THE LOWER CONNECTICUT RIVER AND THE EFFECTS OF THE CONNECTICUT YANKEE PLANT, NUS Corp., Pittsburgh, PA. Ecological Sciences Div.

B. C. Marcy, Jr.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No 1, 1976 Merriman, D., and Thorpe, L. M., (eds.) p 61-113, 20 fig, 48 tab, 164 ref.

Descriptors: Environmental effects, *Water pollution, *Thermal pollution, Powerplants, *Nuclear powerplants, *Fish populations, Discharge(Water), Effluent, *Connecticut River.

This study describes changes in the population dynamics and the sport fishery of fishes in the vicinity of the Connecticut Yankee Plant in the years 1965-1972. Some 229,933 fish representing 44 species and 21 families were collected in 1,398 bag-seine and trawl hauls. The study details the composition and relative and seasonal abundance of fish species regularly sampled at frequent intervals at eight stations for both young and adults. Life-history data are presented for the four most abundant species: white perch, spottail shiner, brown bullhead, and white catfish. After the plant began to operate, there was a significant reduction in the number of these species at the heated stations as well as a significant reduction in the number of white catfish and spottail shiners at the control stations. Two distinct seasonal peaks oc-

curred in the fish population in the canal, one in March and April and another in November and December with the number of fishes remaining relatively constant from May through October. (See also W78-04174) (Chilton-ORNL)

W78-04182

HYDROGRAPHY, Essex Marine Lab., CT. W. A. Boyd.

In: The Connecticut River Ecological Study, The Impact of a Nuclear Power Plant, American Fisheries Society, Monograph No 1, 1976 Merriman, D., and Thorpe, L. M., (eds.) p 25-34, 15 fig, 1 tab, 8 ref.

Descriptors: *Environmental effects, *Water pollution, Thermal pollution, Powerplants, *Nuclear powerplants, *Hydrography, Discharge(Water), Effluents, Oxygen.

This paper on lower case hydrography outlines the operating history of the Connecticut Yankee plant 1967-1972, discusses the Connecticut River discharge and climatological conditions, and describes the hydrographic monitoring system. Normal upstream limit of significant salinity from seawater incursion was found to be well below the thermal plume from the plant. Proximity of brackish water permits the occasional presence of halohaline species. Long- and short-term studies of oxygen concentrations showed no measurable effect attributable to the operation of the plant. The area and extent of the thermal plume varied so widely under the broad spectrum of conditions imposed by river discharge and tidal flow that averages are mere indicants but, under normal or low-flow conditions surface temperatures usually showed elevations up to 8°C at least once each day. (See also W78-04174) (Chilton-ORNL)

W78-04183

EFFECTS OF LIGHT INTENSITY AND TEMPERATURE ON CRYPTOMONAS OVATA (CRYPTOPHYCEAE) GROWTH AND NUTRIENT UPTAKE RATES, Washington State Univ., Pullman. Dept. of Zoology.

J. E. Cloern.

Journal of Phycology, Vol. 13, No. 4, December 1977, p 389-395, 8 fig, 1 tab, 42 ref.

Descriptors: Environmental effects, *Light intensity, *Temperature, *Growth rates, Algae, Nutrients, Nutrient requirements, Nitrates, Phosphates, Ammonium compounds, Absorption, *Cryptomonas ovata, Cryptomonads, Uptake rates, *Nutrient uptake kinetics.

The response of Cryptomonas ovata growth to light is described by Steele's function at 8 and 26°C where light inhibition was observed but the organism was found to be more tolerant of higher light intensities in the range of 14-20°C. Both maximum growth rate and optimum light intensity were depressed at 26°C, suggesting a temperature inhibition. The optimum growth temperature was found to be between 20 and 26°C. Nutrient uptake studies showed that substrate-saturated nitrate uptake was slow in the dark and stimulated by increase in temperature and light; ammonium uptake proceeded at a basal rate at 8 and 14°C and was stimulated by increase of temperature and light. Ammonium uptake rates were higher than nitrate uptake rates at all light-temperature combinations. C. ovata was found to take up phosphate over a wide range of light-temperature conditions. (Chilton-ORNL)

W78-04185

RELATION OF WATER TEMPERATURE TO BACTERIAL KIDNEY DISEASE IN COHO SALMON (ONCORHYNCHUS KISUTCH),

SOCKEYE SALMON (O. NERKA), AND STEELHEAD TROUT (SALMO GAIRDNERI), Oregon State Univ., Corvallis. Dept. of Microbiology.

J. E. Sanders, K. S. Pilcher, and J. L. Fryer. Journal of the Fisheries Research Board of Canada, Vol. 35, No. 1, January 1978, p 8-11, 3 tab, 9 ref. EPA 18050 DU and R 800171.

Descriptors: Environmental effects, *Water temperature, Disease, Fish diseases, Salmonids, Bacteria, Mortality, Salmon, Sockeye salmon, Trout, *Thermal stress, *Bacterial kidney disease(Fish), Coho salmon, *Steelhead trout.

The strains of the *Corynebacterium* species causing kidney disease were injected into the three species of fish at varying temperatures from 3.9 to 20.5°C. Mortality was essentially 100% in sockeye salmon at all temperatures from 6.7 to 20.5°C and was greatest in coho salmon and steelhead trout at 6.7-12.2°C. Mortality in these two species declined at temperatures above 12.2°C. Mean number of days between infection and death was shortest in all three species at higher temperatures, varying from 21-34 days at 15.0-20.5°C. Mean number of days between infection and death at 6.7°C ranged from 60-71 days in the three species. (Chilton-ORNL)

W78-04186

USE OF OPERATIVE INFORMATION ON SANITARY VIOLATIONS OF THE ENVIRONMENT, (IN RUSSIAN), Municipal Sanitary Epidemiology Station, Novokuznetsk (USSR).

O. I. Samuilo, E. M. Deeva, Z. F. Karpova, and N. A. Kozlova. Gig Sanit 1, p 95-97, 1977.

Descriptors: *Public health, *Water quality standards, Environment, Diseases, Water pollution effects, Bacteria, *Human diseases, Infection.

A system of information for environmental damage with goal of isolating potential dangers for humans was discussed. Critical situations were environmental violations defined in terms of possible harmful changes in the environment. Accidents with technological equipment, changes in bacterial evaluations of food or water, occupational diseases, food poisoning, and infectious illnesses were all included. Monitoring this type of information could allow prognoses on health of people to be made. Copyright 1978, Biological Abstracts, Inc.

W78-04188

PHYTOPLANKTON SUMMER STANDING CROP AND ANNUAL PRODUCTIVITY AS FUNCTIONS OF PHOSPHORUS LOADING AND VARIOUS PHYSICAL FACTORS, Cornell Univ., NY. Dept. of Natural Resources. R. T. Oglesby.

Journal of the Fisheries Research Board of Canada, Vol 34, 1977, p 2255-2270. 13 fig, 4 tab, 93 ref.

Descriptors: Environmental effects, Lakes, *Productivity, *Standing crop, *Phytoplankton, *Phosphorus, Trophic level, Eutrophication, Primary productivity, Lake morphology, Summer, Seasonal, Water pollution effects, Morphoedaphic index.

Lakes ranging over a wide spectrum of morphologies, trophic states, hydrologies and light regimes are represented in the study. When mixing of the water column was taken into account, it was found that standing crop was highly correlated with dissolved phosphorus loading. In lakes with a mean depth > 25 m, areal loading accounted for 97% of the variance in summer phytoplankton standing crop. In shallower lakes, phosphorus inputs were adjusted to give a simple approximation of the influence of mixing processes and the ratio of bot-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects Of Pollution

tom area to overlying water volume. Annual primary productivity was a more complex and variable function of phosphorus loading than was summer standing crop. (Chilton-ORNL) W78-04189

RELEASE OF MERCURY AND ORGANICS FROM RESUSPENDED NEAR-SHORE SEDIMENTS,

Florida State Univ., Tallahassee.
S. E. Lindberg, and R. C. Hariss.
Journal Water Pollution Control Federation, December 1977, p 2479-2487. 4 fig, 2 tab, 32 ref.

Descriptors: *Environmental effects, *Sedimentation, Suspension, Mercury, Estuaries, Rivers, Mobile Bay, Everglades National Park(Fla), Deposition(Sediments), Sediment-water interfaces, Dredging, *Mobile Bay(Ala), Florida, Alabama, Resuspension, Redeposition.

A field study was designed to examine the kinetics of mercury sediment-water interaction during periods of intense sediment-water mixing, using near-shore marsh sediments and dredge spoil sediment collected from Mobile Bay and riverine and estuarine organic-rich sediments from the Everglades National Park. Similar behavior of mercury during resuspension of sediments from each of the environments was noted. The mechanisms controlling the patterns of mercury release and redeposition were related to variations in pH, redox potential, total dissolved sulfide and dissolved organic carbon concentration, but, in no case, was a consistent pattern of any of these measured variables observed. Results suggest that large-scale resuspension of estuarine sediments by processes such as dredging operations causes a temporary release of dissolved mercury into the surrounding water followed by a decrease to levels close to those predicted by ideal dilution calculations. The results also illustrate the problems associated with assessing the environmental impact of dredging. (Chilton-ORNL) W78-04192

SEDIMENT CONTAMINATION AND BENTHIC MACROINVERTEBRATE DISTRIBUTION IN A METAL-IMPACTED LAKE,

Purdue Univ., Lafayette, Ind. Dept. of Biomolecules.
R. Wentsel, A. McIntosh, and V. Anderson.
Environmental Pollution, Vol. 14, 1977, p 187-193, 2 fig, 1 tab, 8 ref.

Descriptors: Environmental effects, *Water pollution, Effluents, Heavy metals, *Toxicity, *Benthos, *Invertebrates(Distribution), Populations, Cadmium, Zinc, Chromium, Sediments, Lakes, *Lake sediments, Industrial wastes, *Metals.

The study site, Palestine Lake, Indiana, was contaminated by effluents from an electroplating plant. Samples of the upper 3 cm of sediment were collected from five sites for metal analysis. Levels ranged from a high of 969 ppm Cd, 14,032 ppm Zn and 2106 ppm Cr near the effluent to lows of 4 ppm Cd, 139 ppm Zn and 38 ppm Cr in a distant portion of the lake. Numbers of the oligochaete *Limnodrilus* sp were highest at stations near the effluent and decreased at distant stations while chironomid populations were near zero at sites near the effluent and increased at distant stations. It was suggested that elimination of competitors probably accounts for the high population number of the oligochaete *Limnodrilus* sp near the effluent. No mechanism enabling these organisms to survive in such areas is apparent. (Chilton-ORNL) W78-04193

OCCURRENCE OF METHYL MERCURY IN PIKE AND BALTIK HERRING FROM THE TURKU ARCHIPELAGO,

Turku Univ. (Finland). Inst. of Biochemistry. R. R. Linko, and K. Terho.

Environmental Pollution, Vol. 14, 1977, p 227-235, 1 fig, 3 tab, 35 ref.

Descriptors: Environmental effects, *Water pollution, *Mercury, Fish, *Finland, *Herrings, *Pikes, Turku Archipelago(Finland), Baltic Sea, Baltic pike, Bioaccumulation, *Methyl mercury.

The mean level of methyl mercury found in pike from the Turku archipelago was 0.27 mg/kg but the concentrations varied considerably between individuals from the same fish population. There was evidence of a linear relationship between the methyl mercury concentration and the weight (and age) of fish. Highest methyl mercury level was found in pike from the inner archipelago near the city of Turku. Herring from the Turku archipelago contained markedly lower concentrations of methyl mercury than pike, the mean value, 0.09 mg/kg, being only about one-third that found in pike. (Chilton-ORNL) W78-04194

EFFECTS OF METHANOL ON THE FERTILISATION OF CHUM SALMON (ONCORHYNCHUS KETA) OVA,

Aquatic Environments Ltd., Nanaimo (British Columbia).

P. C. Craig, F. C. Withler, and R. B. Morley. Environmental Pollution, Vol. 14, 1977, p 85-91, 3 tab, 8 ref.

Descriptors: Environmental effects, *Water pollution effects, Reproduction, *Salmon, Antifreeze, Eggs, Hatching, Fertilization, *Chum salmon, *Methanol, Gametes.

Both gametes and fertilized eggs were subjected to methanol concentrations of 0.001, 0.01, 0.1, 1.0 and 10.0% by volume. Results showed that methanol concentrations up to and including 1.0% did not significantly affect fertilization success, survival to hatching, hatching time, alevin size at hatching or physical deformities among alevins. A 10.0% concentration of methanol was lethal in most cases even for short exposures. It was concluded that while these results suggest that a short exposure to spilled methanol diluted in a receiving stream would not affect the viability of deposited ova and sperm, the methanol used in these tests was reagent grade and that the combined effects due to contaminants which vary in kind and proportion in industrial grade antifreeze (from which some methanol spillage occurs) are not known. (Chilton-ORNL) W78-04195

THE EFFECT OF ROAD DEICING SALT ON THE DRIFT OF STREAM BENTHOS,

Waterloo Univ. (Ontario). Dept. of Biology. For primary bibliographic entry see Field 5B. W78-04196

THE EFFECTS OF SEWAGE SLUDGE ON THE GROWTH RATE OF CARP, CYPRINUS CARPIO L.

Chinese Univ. of Hong Kong. Dept. of Biology. S. W. Yip, and M. H. Wong. Environmental Pollution, Vol. 14, 1977, p 127-132, 1 fig, 3 tab, 10 ref.

Descriptors: Environmental effects, *Water pollution, *Sludge disposal, Fish, Fish farming, Heavy metals, Toxicity, *Carp, *Growth rates, *Sewage sludge.

Carp reared in tap water to which sludge had been added to give a sludge concentration of 0.2%, or in sewage effluent, had higher growth rates than carp reared in tap water alone. Fish in 0.6 and 0.8% media appeared unhealthy during the culture period. It was suggested that this might be due to accumulation of sludge particles containing high concentrations of heavy metals in the vicinity of the gills and that these accumulations may have

been the cause of observed mortalities. (Chilton-ORNL) W78-04197

THE OCCURRENCE OF SOME HEAVY METALS IN POPULATIONS OF THE FRESH-WATER MUSSEL ANODONTA ANATINA (L.) FROM THE RIVER THAMES,

Kingston Polytechnic, Kingston upon Thames (England). School of Chemical and Physical Sciences.

For primary bibliographic entry see Field 5B. W78-04198

WATER QUALITY IN THE FORTH ESTUARY: A DISCRIMINANT FUNCTIONAL ANALYSIS,

Napier Coll. of Commerce and Technology, Edinburgh (Scotland).

For primary bibliographic entry see Field 5A. W78-04199

5D. Waste Treatment Processes

DREDGED MATERIAL DENSIFICATION AND TREATMENT OF CONTAMINATED DREDGED MATERIAL,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects Lab. For primary bibliographic entry see Field 5G. W78-03750

SWINE LAGOON EFFLUENT ON A SOIL-PLANT ENVIRONMENT: AN IMPACT ASSESSMENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering. E. R. Collins, Jr., E. T. Kornegay, and D. C. Martens.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 124, Price codes: A03 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin 110, January 1978. 38 p, 34 tab, 1 fig, 12 ref. OWR A-063-VA(1).

Descriptors: Farm wastes, *Swine waste treatment, *Farm lagoons, Hogs, *Biological treatment, *Aerated lagoons, Heavy metals, Waste water disposal, *Waste water treatment, Oxidation lagoons, Land disposal, Swine waste irrigation.

Two biological treatment units for a swine production unit were evaluated. One unit was maintained as an anaerobic system, the other as a mixed aerated unit by means of a floating mechanical aerator. Wastes were flushed into each unit by recirculation of effluent. Analysis of the supernatant of both systems showed that, with time, accumulations of heavy metals and other elements increased. Effluent from both treatment systems was irrigated on fescue plots, and effects on soil, soil water, and plant tissue were determined. While no visible deleterious effects were noted over a period of one and one half years, accumulation or high uptake of Na, Cu, and Zn was recorded in both plant tissue and soils; over extended periods, these effects could be serious if not controlled. Nitrate leaching from plots was minimal. Other waste constituents measured did not appear to be limiting factors in land disposal of swine lagoon effluent. W78-03755

THE PHASED CLEAN-UP PROGRAM, KANAWHA RIVER,

For primary bibliographic entry see Field 5G. W78-03821

ALGAE HARVESTING FROM SEWAGE.

Caldwell Connell Engineers Pty. Ltd., Canberra (Australia).

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Waste Treatment Processes—Group 5D

For primary bibliographic entry see Field 5G.
W78-03843

WATER CONSERVATION IN INDUSTRIAL FILTRATION OPERATIONS, Arkansas Univ., Fayetteville. Coll. of Engineering.

J. L. Turpin.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 356, Price codes: A04 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Publication No. 53, September 1977. 50 p, 20 fig, 2 tab, 9 ref, 3 append. OWRT A-035-ARK(1).

Descriptors: *Filter cake washing, *Saturated washing, *Unsaturated washing, Industrial wastes, Water conservation, Filtration, Computer program, Mathematical models, *Waste water treatment.

The washing of a solute from filter cakes was investigated for both saturated and unsaturated washing conditions. Systems used in this experimental study were 0.065 NaCl solution as the filtrate in an aluminum hydrate filter cake and 0.1 Normal HCl solution as the filtrate in a column packed with glass beads. The filtrate concentration as a function of the flow rate of wash water and of the volume of effluent from the pack bed was measured. The amounts of filtrate removed from the bed during saturated washing and washing employing repetitive steps of saturation followed by evacuation were compared. Also, the amounts of wash water required to lower the filtrate concentration to essentially zero were contrasted. The saturated wash condition was more efficient in removing the filtrate from compressible cakes, while the reverse was true for porous, incompressible cakes. Computer programs were developed to simulate both saturated and unsaturated washing conditions.

W78-03932

CHEMICAL AND BIOLOGICAL STUDIES ASSOCIATED WITH THE RECOVERY OF THE RIVER EBBW FAWR (1970-74),
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5G.
W78-03953

FEEDLOT RUNOFF AND SEWAGE EFFLUENT AS POTENTIAL WATER POLLUTANTS WITH EMPHASIS ON NITROGEN AND PHOSPHATE LEVELS AND OXYGEN DEPLETION,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Chemistry; and New Mexico Inst. of Mining and Technology, Socorro. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W78-03968

THE JAPANESE REGIONAL WASTEWATER TREATMENT SYSTEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering; and Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
E. D. Brill, Jr., and M. Nakamura.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 531, Price codes: A03 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, Research Report No 129, October 1977. 40 p, 5 tab, 4 fig, 4 ref. OWRT A-082-ILL(1).

Descriptors: Management, Pollution, *Sewage treatment, *Waste water treatment, *Japan, *Treatment facilities, *Water pollution control, Cost effectiveness, Institutional arrangements, Regional planning, Social issues.

The Japanese government is undertaking a major program to provide additional sewage collection and treatment because of the severe water pollution that has resulted from rapid urbanization and industrialization. The program is characterized by strong regional planning and by the utilization of central treatment plants serving many communities and, in some cases, industries. Through a study carried out in Japan many important planning issues were identified, including: (1) cultural and historical factors; (2) cost effectiveness, including economies of scale, treatment effectiveness, and short-run and long-run flexibility; (3) potential interrelationships with drainage, water supply, and land use; (4) interactions between planning agencies and local citizens; and (5) institutional arrangements between governmental bodies. The Japanese experience is a significant one in the history of planning wastewater treatment systems and provides some guidance as similar programs are initiated in other developing countries throughout the world.

W78-03969

HIGH-RATE DISINFECTION: CHLORINE VERSUS CHLORINE DIOXIDE,

O'Brien and Gere Engineers, Inc., Syracuse, NY. D. F. Geisser, and S. R. Garver.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 103, No EE6, p 1089-1103, December 1977. 10 fig, 5 tab, 17 equ, 14 ref. EPA Y005141.

Descriptors: *Water pollution control, *Disinfection, *Optimization, *Mixing, *Intensity, *Chlorine, *Chlorine dioxide, Cost-benefit analysis, Multiple regression analysis, Cost minimization, Mathematical models, Equations, *Overflow, *Combined sewers, Environmental engineering, Sewage treatment, Sanitary engineering, Systems analysis, Rochester(NY), New York.

High-rate disinfection of combined sewer overflows with chlorine and chlorine dioxide is evaluated using multiple regression analysis. Mathematical methods of both systems are developed and a performance comparison of the two disinfectants is presented. The performance models indicate that disinfection by chlorine is more sensitive to mixing intensity and detention time than is chlorine dioxide. Using cost-benefit analysis, cost equations and the performance models are employed to derive minimum cost systems for conditions typical of Rochester, New York. The optimizations indicate that, although chlorine dioxide permits the use of lower detention time facilities, chlorine results in lower overall system costs.

(Bell-Cornell)

W78-03992

DECISIONS ABOUT WASTEWATER

TECHNOLOGY: 1850-1932, Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of History, Technology, and Urban Affairs. J. A. Tarr, and F. C. McMichael.

Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 103, No WR1, p 47-61, May 1977. 47 ref.

Descriptors: *Sewage treatment, *Sewers, *Water treatment, *Regulation, *History, Water supply, Sewerage, Sewage disposal, Households, Tap water, Public works.

This paper focuses upon key turning points in the evolution of methods of collecting and treating domestic wastes during the period 1850 to 1932 and suggests that there are many analogies between today's water quality movement and that of the past. The 1850-1932 time span can be divided into three periods: 1850-1880, 1880-1900, and 1900-1932. Each of these periods was dominated by the marking of a critical decision in terms of dealing with domestic wastes. The three

decisions examined herein are the adoption of a system of sewers using water for transport of wastes, the decision to build combined rather than separate sewers, and the decision to treat raw water supplies rather than to treat waste before disposal to waterways. These decisions led to unanticipated results, results that necessitated new technologies and that led to an expansion of governmental regulation in the area of water quality. (Bell-Cornell)

W78-03996

PURIFICATION OF SULFITE MILL EFFLUENTS BY THE ELECTROCHEMICAL METHOD (OCHISTKA PROMYSHLENNYKH STOKOV SUL'FITNO-TSELLYULOZNOGO PROIZVODSTVA ELEKTROKHIMICHESKIM SPOSOBOM),

Vsesoyuzny Nauchnyi Planovii Otdel Bumazhnoi Promyshlennosti, Moscow (USSR).

A. D. Venderevskii, G. N. Galyatin, R. F.

Ofengein, V. I. Pershin, and T. P. Pershina.

Bumazhnaya Promyshlennost, No. 5, p 23-24, May, 1977. 1 tab.

Descriptors: *Pulp wastes, *Sulfite liquors, *Waste water treatment, *Electrochemistry, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Pulp and paper industry, Effluents, Aluminum, Electrodes, Direct currents, Chemical oxygen demand, Color, Hydrogen ion concentration, Energy, Chemical reactions, Sulfite pulp mills.

Model sulfite mill effluent (COD of 2000-2500, pH of 3-4) was purified by the electrochemical process in a 10-liter column under static and dynamic conditions. The column contained Al electrodes, and the process was carried out with direct current of different strength. A 20-min process reduced COD at least 50% and color at least 80%. The pH increased to 5-6 and the energy consumption was 3-4 kw-hr/cu m. The experiments were repeated with actual mill effluent (COD of 500-1500, pH 3-4, fiber content 100-150 mg/liter) obtained in the production of unbleached sulfite pulp and wrapping paper. The purification effectiveness and energy consumption were about the same as with the model effluent. Chemical reactions taking place during the electrochemical purification process are discussed. The construction of experimental equipment for electrochemical effluent purification is recommended. (Stapinski-IPC)

W78-04065

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PULP AND PAPER INDUSTRY - 1976.

Department of the Environment, Ottawa (Ontario). Water Pollution Control Directorate.

Environmental Protection Service, Economic and Technical Review, Report EPS 3-WP-77-9, 35 p, September, 1977. 2 fig, 10 tab, append.

Descriptors: *Water pollution control, *Canada, *Pulp and paper industry, Pulp wastes, Wastes, Industrial waste, Water pollution treatment, Water pollution sources, Suspended solids, Biochemical oxygen demand, Costs, Capital costs, Foreign countries, Energy, Sludge disposal, Nutrients, Pollution abatement, Sulfite pulp mills, Newsprint mills, Spent sulfite liquors.

During the period 1974 to 1976, pulp and paper production remained essentially unchanged. Total suspended solids (TSS) were reduced by 6% and BOD by 15%. Two-thirds of the reduction in BOD was due to the closure of a sulfite mill at Prince Rupert, B.C. Although many mills (83% of production for TSS and 71% of production for BOD) presently have compliance programs, there are still some with no programs. In the period 1960 to 1976, inclusive, expenditures for abatement facilities amounted to ca. \$450,000,000. Effluent abatement at integrated newsprint/sulfite mills continues to pose the most difficult problem. These

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Group 5D—Waste Treatment Processes

mill are centered in the Quebec, Ontario, and Atlantic regions, and many are old and small in size. Abatement facilities, such as liquor recovery and incineration, have not been installed. Alternative abatement measures, such as biological treatment of spent sulfite liquor, are undesirable because they could result in high energy consumption, serious sludge disposal problems, high nutrient loads on the receiving streams and, more importantly, only the biodegradable portion of the dissolved organic materials discharged from the process would be removed. At a few specific sites, one potential solution may involve consolidation of several small mills into a large operation. Process changes, such as the use of thermomechanical pulp, may be other possible solutions. Several mills have shut down their sulfite operations and are using purchased kraft pulp as their chemical furnish. (Witt-IPC)

W78-04066

ESTIMATE OF COSTS FOR WATER POLLUTION CONTROL MEASURES IN THE PULP AND PAPER INDUSTRY.

Department of the Environment, Ottawa (Ontario). Water Pollution Control Directorate. For primary bibliographic entry see Field 5G.

W78-04067

ABITIBI (PAPER COMPANY LTD.) IN SMOOTH ROCK FALLS (ONTARIO) REAPS THE BENEFITS OF IMPROVED WASTE TREATMENT.

For primary bibliographic entry see Field 3E.

W78-04069

SOLID-SHANDLING PROCESS STUDIES — ALASKA LUMBER AND PULP (INC.),

Edde (Howard), Inc., Bellevue, WA.

H. J. Edde.

Canadian Pulp and Paper Association, Technical Section, 63rd Annual Meeting (Montreal), February, 1977, Preprint, p A113-A117. 8 ref, 7 tab.

Descriptors: *Pulp wastes, *Sulfite liquors, *Waste water treatment, *Biological treatment, *Waste treatment, Wastes, Industrial wastes, Water pollution treatment, Water pollution sources, Biochemical oxygen demand, Alaska, *Sludge treatment, *Dewatering, Centrifugation, Filtration, Activated sludge, Sludge disposal, Incineration, Effluents, Pulp and paper industry, Sulfite pulp mills.

Process design studies were conducted at a sulfite (dissolving-grade) pulp mill owned by Alaska Lumber and Pulp Inc. in Sitka, Alaska, to reduce the 5-day BOD of its organic waste discharges from 175,000 to 48,000 lb BOD/day, biological sludge dewatering by thickening, centrifugation, vacuum filtration, pressure filtration, or solvent extraction was studied at 3 secondary-treatment pilot plants, viz., air-activated sludge (AAS), high-purity oxygen-activated sludge, and rotating biotreat systems. Inplant controls reduced the BOD to 110,000 lb/day, thus reducing the BOD load to be removed by the biological treatment plant and the amount of biological waste solids by one-half. Sludge generated in the AAS plant under construction will be mixed with primary sludge with or without the use of bark fines for conditioning. This mixture will be directed to the existing vacuum coil filter followed by a Reitz V-Press for dewatering. The dewatered sludge will then be burned in the existing hog fuel boiler. (Swichtenberg-IPC)

W78-04071

BIODEGRADABILITY OF TOXIC COMPOUNDS IN PULP MILL EFFLUENTS,

B. C. Research Ltd., Vancouver.

For primary bibliographic entry see Field 5B.

W78-04072

BIODEGRADATION OF SPENT BISULFITE LIQUOR IN A TWO-STAGE IN-SERIES REACTOR (EPURATION BIOLOGIQUE DE LA LIQUEUR AU BISULFITE DANS UN REACTEUR A DEUX STAGES EN SERIE),

Laval Univ., Quebec.

M. G. Tricart, S. N. Lo, J. J. Garceau, and A.

Charette.

Canadian Pulp and Paper Association, Technical Section, 63rd Annual Meeting (Montreal), February, 1977, Preprint, p B23-B30. 7 fig, 15 ref, 1 tab.

Descriptors: *Pulp wastes, *Sulfite liquors, *Activated sludge, *Waste water treatment, Wastes, Industrial wastes, Water pollution treatment, Water pollution sources, Waste treatment, Dissolved solids, Biochemical oxygen demand, Biological treatment, Time, Pulp and paper industry, Effluents, Sulfite pulp mills, Spent sulfite liquor.

Biodegradation of spent liquor from high-yield bisulfite pulping was carried out on a laboratory scale, using an activated sludge reactor made up of two stages in series. The influence of incoming dissolved solids concentration and residence period on sludge concentration and system yield was examined. BOD removals of more than 66% were obtained at residence periods of more than 24 hr in each stage. Such two-stage activated sludge treatment shows a better yield than one-stage, it permits meeting BOD removal standards in processing only the concentrated portion of the liquor. This mode of treatment thus appears to be a short-term solution for mills producing less than 300 tons/day of high-yield bisulfite pulp. In addition, the system is well suited to periodic expansion as required by progressively more stringent pollution control standards. (Speckhard-IPC)

W78-04073

MEMBRANE FILTRATION OF SSL (SPENT SULFITE LIQUOR) FOR RECOVERY OF BY-PRODUCTS AND POLLUTION CONTROL,

DDS RO Div. (Denmark). Dept. of Pulp and Paper. P. H. Claussen.

Canadian Pulp and Paper Association, Technical Section, 63rd Annual Meeting (Montreal), February, 1977, Preprints, p B125-B130. 3 illus, 8 fig, 3 tab.

Descriptors: *Pulp wastes, *Sulfite liquors, *Waste water treatment, *Reverse osmosis, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Membrane processes, Separation techniques, Foreign countries, Europe, Water reuse, Costs, Water pollution control, Byproducts, Pulp and paper industry, Effluents, Lignins, Sulfonates, *Ultrafiltration, Spent sulfite liquor, Norway, Sulfite pulp mills.

Brief descriptions are given of ultrafiltration and reverse osmosis membrane modules developed by a Danish company for the treatment of pulp and paper mill effluents. The purification of lignosulfonates from spent sulfite liquor (SSL) by ultrafiltration and the reverse osmosis treatment of dilute SSL and wash waters are discussed. A reverse osmosis plant has been operating at a Norwegian sulfite mill since September, 1976. This plant, processing 14 cu m/hr of dilute SSL, increases the solids concentration 6 to 12%. Permeate discharge rate is 7 cu m/hr. The permeate has a sulfur dioxide content of 0.75% and is reused in the bleaching plant for neutralization after the hypochlorite stage. Several suggestions are offered for using membrane filtration equipment as parts of larger integrated systems for the treatment of pulp mill effluents. Tabulated data are presented showing the mass balance, concentration data, capacity, and cost of ultrafiltration and reverse osmosis treatment of SSL using coarse and dense filtration membranes. (Witt-IPC)

W78-04074

STUDIES ON THE APPLICATIONS OF MEMBRANE TECHNIQUES IN WASTE EFFLUENT TREATMENT FOR WATER AND CHEMICAL RECLAMATION ALONG WITH POLLUTION ABATEMENT,

Indian Inst. of Tech., Bombay (India). Dept. of Chemical Engineering. S. Basu.

Chemical Age of India, Vol 27, No 12, p 1086-1091, December, 1976. 7 fig, 11 ref, 5 tab.

Descriptors: *Electrodialysis, *Reverse osmosis, *Waste water treatment, *Pulp wastes, *Sulfite liquors, Waste treatment, Water pollution treatment, Wastes, Industrial wastes, Water pollution sources, Costs, Membrane processes, Osmosis, Separation techniques, Pulp and paper industry, Effluents, Water pollution control, Spent sulfite liquor, Black liquors.

Following an introduction to the principles of reverse osmosis and electrodialysis, the electrodialytic regeneration to spent pulping liquors is reviewed. Covered are the barrier-anolyte-liquor-catholyte (BALC) system and the transport-depletion process for treating spent sulfite liquors, as well as electromembrane systems applicable to kraft black liquor. Also presented is a cost-benefit analysis of membrane systems for effluent treatment. The techno-economic feasibility of electrodialytic regeneration of spent sulfite liquor and of membrane techniques as advanced waste-water treatment processes is examined. (Speckhard-IPC)

W78-04075

ABSORPTION OF OXYGEN IN AQUEOUS SOLUTIONS OF SODIUM SULFIDE IN THE PRESENCE OF ACTIVATED CARBON AS CATALYST,

Bombay Univ. (India). Dept. of Chemical Engineering.

K. Chandrasekaran, and M. M. Sharma.

Chemical Engineering Science, Vol 32, No 6, p 669-671, 1977. 4 fig, 10 ref, 1 tab.

Descriptors: *Activated carbon, *Oxidation, *Catalysts, *Pulp wastes, Oxygen, Diffusion, Chemical reactions, Waste water treatment, Water pollution sources, Water pollution treatment, Sodium compounds, Sulfides, Inorganic compounds, *Absorption, *Sodium sulfide, Black liquors.

The influence of activated carbon as catalyst in the oxidation of sodium sulfide in aqueous solution was studied under conditions corresponding to industrial oxidation of kraft black liquor. The activated carbon was found to catalyze the reaction markedly and to cause it to be controlled by diffusion of oxygen into the liquid phase. (Speckhard-IPC)

W78-04077

MEASURING THE COST OF INDUSTRIAL WATER POLLUTION CONTROL,

For primary bibliographic entry see Field 5G.

W78-04079

RECENT TREND OF EFFLUENT TREATMENT,

Sanyo-Kokusaku Pulp Co., Ltd., Tokyo (Japan).

A. Yamaguchi.

Japan Pulp and Paper, Vol. 15, No. 1, p 38-41, April, 1977. 1 fig, 3 tab.

Descriptors: *Pulp wastes, *Waste water treatment, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Activated carbon, Electrolysis, Sludge, Chemical oxygen, Biochemical oxygen demand, Color, Suspended solids, Bark, Wood wastes, Foreign countries, Pulp and paper industry, Effluents, Biological treatment, *Japan.

Effluent treatment methods (activated carbon treatment and electrolysis) are reviewed and possi-

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ble uses for sludge are outlined. The efficiency of various effluent treatment systems (physicochemical and biological) for removing COD, BOD, color, and suspended solids shown, and a flowsheet of the activated carbon process (tons/year) and disposal in the Japanese pulp and paper industry are indicated. (Buchanan-IPC)

W78-04080

ABSORPTION METHOD FOR DETERMINING ACTIVATED SLUDGE CONCENTRATIONS DURING PURIFICATION OF EFFLUENTS FROM VISCOSA PRODUCTION
 (ABSORBTIONNOE OPREDELLENIE KONTSENTRATSIIS AKTIVNOGO ILA PRI BIKHIMICHESKOI OCHISTKE STOCHNYKH VOD VIZKOZNOGO PROIZVODSTVA),
 For primary bibliographic entry see Field 5A.

W78-04081

THE SIGNIFICANCE OF THE (GERMAN) WASTEWATER DISCHARGE TAX LAW AND ITS FEE-COMPUTING FORMULA FOR THE PULP INDUSTRY (DIE BEDEUTUNG DES ABWASSERABGABENGESETZES NACH MASSGABE DER BEMESSUNGSSFORMEL FUER DIE ZELLSTOFFINDUSTRIE),
 Papierwerke Waldhof-Aschaffenburg A. G., Raubling (West Germany).
 For primary bibliographic entry see Field 5G.

W78-04082

PULP AND PAPER MANUFACTURE: ENERGY CONSERVATION AND POLLUTION PREVENTION,
 Noyes Data Corp., Park Ridge, NJ.

M. Sittig.
 Pollution Technology Review No. 36/Energy Technology Review No. 17. September 15, 1977. 430 p.

Descriptors: *Pulp and paper industry, *Energy, *Conservation, *Pollution abatement, *Reviews, Fuels, Coals, Oil, Bark, Wood wastes, Water consumption (Except consumptive use), Water pollution, Water pollution control, Waste water treatment, Biochemical oxygen demand, Color, Mercury, Sludge treatment, Dewatering, Sludge disposal, Air pollution, Bleaching wastes, Odor, Water pollution sources, Byproducts, Patents, Pulp wastes, Pulpwood, Barking, Chipping, Mechanical pulping, Thermomechanical pulping, Chemical pulping, Neutral sulfite semichemical pulping, Waste paper, Black liquors, Kraft mills, Sulfite pulp mills.

The technical details presented in this review are based largely on information reported in government-funded studies and U.S. patents. The subject matter is organized into the following main chapters and sub-chapters: paper and paperboard industry process descriptions (pulpwood acquisition, barking, chipping, groundwood and thermomechanical pulping, neutral sulfite semichemical and chemical pulping, waste paper pulping, pulp bleaching, paper and board production, and converting); types of fuels used (oil, gas, coal, bark and hogged fuel, black liquor); energy consumption patterns; factors affecting energy efficiency; energy conservation approaches and targets; water requirements; water pollution problems; in-house wastewater control (spill containment, by-product recovery, etc.); external wastewater treatment (solids removal, BOD reduction, color removal, mercury removal, sludge dewatering and disposal, compatibility with municipal systems, etc.); air pollutant emissions and their control; kraft process and sulfite mill air emissions and control; miscellaneous mill air emissions and control (bleach plant gases, wastewater treatment gases, odor problems, power boiler flue gases). (Brown-IPC)

W78-04084

SOME INFORMATION ON EVAPORATOR INSTALLATIONS (EINIGES UEBER VERDAMPFERRANLAGEN),
 H. G. Frank.

Der Papiermacher, Vol. 27, No. 9, p 149-151, 155-158, September 24, 1977. 6 fig, 2 illus.

Descriptors: *Evaporators, *Pulp wastes, *Design, Automatic control, Evaporation, Heat transfer, Pressure, Temperature, Equipment, Water pollution sources, Pulp and paper industry, Effluents, *Spent pulping liquors.

Design principles of multiple-effect evaporators for concentrating spent pulping liquors are reviewed. Heat transfer and efficiency and relationship between pressure and temperature are examined. Details discussed include the maximum possible number of stages, the flow of the liquor through the installation, evaporator systems using either forced recirculation of liquor within each stage or compression and recycling of vapors, elimination of noncondensable gases from the system, low-temperature condensation of the vapors from the last stage, and system control. The latter involves level control in the individual stages, determination of the concentration of the concentrated liquor, measurement of the temperature and pressure of the hot steam, and control of the pressure and temperature of the vapors from the last stage. (Speckhard-IPC)

W78-04085

BIOLOGICAL INVESTIGATIONS ON JOINT TREATMENT OF MUNICIPAL SEWAGE AND PULP MILL EFFLUENT,
 Research Institute for Environmental Development, Warsaw (Poland).

L. Kalisz.
 Polskie Archiwum Hydrobiologii, Vol. 23, No. 1, p 155-171, 1976. 6 fig, 15 ref, 4 tab.

Descriptors: *Pulp wastes, *Sulfite liquors, *Activated sludge, *Municipal wastes, *Waste water treatment, Wastes, Industrial wastes, Water pollution treatment, Water pollution sources, Aeration, Bacteria, Effluents, Pulp and paper industry, Waste treatment, Water pollution control, Biological treatment, Microorganisms.

Laboratory studies on conditions and possibilities of joint treatment of municipal sewage and sulfite pulp mill effluent were carried out using the activated sludge method with varying aeration time. In order to establish optimum process parameters, the properties of the activated sludge at various aeration times were determined. Aeration times of 9 and 12 hr were found to be optimum as regards microfaunal composition of the sludge and degree of bacteriological purification. Admixture of pulp mill effluent to the municipal sewage was conducive to abundant development of filamentous bacteria. (Speckhard-IPC)

W78-04086

DECOLORIZATION OF EFFLUENTS FROM PULP MILLS,
 Rohm and Haas Co., Philadelphia, PA. (Assignee).
 S. L. Rock.
 United States Patent No. 4,049,546. September 20, 1977. 5 p, 9 claims.

Descriptors: *Lignins, *Patents, *Waste water treatment, *Pulp wastes, *Color, Ion exchange, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Hydrogen ion concentration, Anion exchange, Resins, Pulp and paper industry, Effluents, Separation techniques, Kraft mills.

A process for removing lignin and lignin by-product color bodies from an unbleached kraft pulp mill effluent stream comprises passing the stream at a pH of 6-8.5 through a mass or bed of macroreticular aliphatic weak anion exchange resin possessing a high pK(a) value of 5-10 in the

free base form. The resin can be a functionalized methyl acrylate/divinylbenzene copolymer. The resin can be regenerated by contact with a pulp mill process stream containing NaOH, and the resultant stream can be used in pulping. (Lynch-IPC)

W78-04087

ADSORPTION CLARIFICATION PLANT OF BAIFENFURT PAPER MILL FOR BLEACH-PLANT EFFLUENTS (ADSORPTIONSKLAERANLAGE DER PAPIERFABRIK BAIFENFURT FUER BLEICHEREIABWASSE),
 Wochenschrift fuer Papierfabrikation, Vol. 105, No. 14, p 557-558, July 31, 1977. 1 fig, 2 illus, 1 tab.

Descriptors: *Bleaching effluents, *Pulp wastes, *Adsorption, Wastes, Industrial wastes, Water pollution treatment, *Waste water treatment, Water pollution sources, Foreign countries, Biochemical oxygen demand, Chemical oxygen demand, Pulp and paper industry, Effluents, *Aluminum oxide, Germany.

The pulp-bleaching effluents from Feldmühle AG, Baienfurt (Germany), have not responded well to biological clarification. The system of effluent treatment described calls for adsorption of the impurities on activated alumina. Such adsorption is shown to reduce 5-day BOD from 275 to 175 and COD from 1800 to less than 350. (Ward-IPC)

W78-04088

EFFLUENT FROM MANUFACTURING OF THERMOMECHANICAL PULPS AND THEIR TREATMENT,
 IWL-Consulting Ltd., Stockholm (Sweden).
 E. Stenberg, and G. Norberg.

In: Proceedings EUCEPA International Mechanical Pulping Conference, June 6-10, 1977, Helsinki, Finland, Volume II, Paper No. 14, 23 p. 10 fig, 11 ref, 7 tab.

Descriptors: *Pulp wastes, *Waste water treatment, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Biochemical oxygen demand, Chemical oxygen demand, Pulp and paper industry, Effluents, Organic matter, Biological treatment, Costs, Pine trees, Aerated lagoons, Evaporation, Coniferous trees, Softwood, Bleaching wastes, Lignins, Costs, *Thermomechanical pulping, White water (Paper machines), Spruce trees (Picea), Mechanical pulping.

In the thermomechanical pulping (TMP) process about 27-37 kg of 7-day BOD/ton is generated compared to 22-27 kg and 12-20 kg for refiner and stone groundwood pulping, respectively. The major part (22-27 kg BOD/ton) is dissolved out of the chips in the first-stage refining of the TMP process, the rest in the chip washers and barkers. If the pulp is peroxide bleached, the additional amount of BOD is about 15-20 kg BOD/ton. About 2/3 of these amounts are discharged to waste waters, and about 1/3 follow the pulp. Pine, sapwood, and fresh wood generate more BOD than do spruce, corewood, and stored wood, respectively. The dissolved substance increases with increasing temperature in the preheater, especially with pine wood and above 120°C. No simple relation between pulp freeness and specific BOD has been found. The BOD/COD and BOD/total organic carbon (TOC) ratios for wet unbleached pulp were similar in the 4 mills studied, viz., about 0.6 and 1.6, respectively. In the white water, BOD/COD was about 0.45 and BOD/TOC was about 1.7. Effluents from TMP and groundwood pulps of *Picea abies* were analyzed before and after biological treatment in an aerated lagoon. BOD reductions were 90% for TMP and unbleached groundwood and 80% for peroxide-bleached groundwood. The effluent from bleached pulp production has a high content of lignins, low-molecular acids, and ash and is readily biodegradable. The transfer of dis-

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

solved organic substances, due to closure of the systems (5 cu m/ton), from pulp mill to paper mill may be reduced by ca. 80% if a washing stage or pressing system is installed. The concentrations of organic substances in the effluent is then increased, and evaporation may become an alternative to the biological treatment of waste waters at the same cost of ca. 35-45 Swedish crowns/ton of pulp. Various BOD and COD reduction measures are compared. (DuVall-IPC)
W78-04090

METHANE FERMENTATION OF EXCESS ACTIVATED SLUDGE (PROBLEMATYKA FERMENTACJI METANOWEJ NADMIERNEGO OSADU CZYNNEGO),
A. Lewandowska-Suschna.
Przeglad Papierniczy, Vol. 33, No 6, p 220-225, June, 1977. 8 fig, 14 ref.

Descriptors: *Methane, *Fermentation, *Activated sludge, *Sludge treatment, *Waste treatment, Wastes, Water pollution sources, Pulp wastes, Industrial wastes, Nitrogen, Carbon, Hydrogen sulfide, Sulfides, Phosphorus, Energy, Gases, Effluents, *Sulfate pulp mills.

Results are presented of experiments on methane fermentation of excess activated sludge from biological purification of sulfite mill effluents. The experiments were carried out under laboratory and pilot plant conditions, and the effectiveness of the fermentation process was evaluated by the amount of gas produced, reduction of the organic substances, and the N/C ratio. The results indicate that methane fermentation can be a suitable method of processing excess activated sludge, and thus prevent its accumulation. The amount of fermentation gas produced averaged 1500 cu cm/g of organic solids eliminated for a short retention time (12-30 days). Sulfides and hydrogen sulfide present in the fermented sediment inhibited fermentation. The conversion of organic nitrogen into ammonia nitrogen during fermentation makes it possible to recycle a part of nitrogen to the activated sludge process. Similarly, the phosphorus contained in the sediment could be recycled. Methane fermentation consumes less energy than the process of oxygen stabilization of excess sludge. (Stapinski-IPC)
W78-04092

IN-PLANT TECHNOLOGY FOR THE PREVENTION OF AIR AND WATER POLLUTION (ZAKLADOWE TECHNOLOGIE ZAPOBIEGANIA ZANIECZYSZCZANIU POWIETRZA I WODY),
IVL-Consulting Ltd., Goteborg (Sweden).
For primary bibliographic entry see Field 5G.
W78-04093

ELECTROMAGNETIC FILTER PURIFICATION OF PAPER MILL CONDENSATE,
Thiimany Pulp and Paper Co., Kaukauna, WI.
R. C. Arnold, R. S. Kopish, D. W. Koch, and G. T. Zirps.
Tappi, Vol. 60, No. 9, p 107-109, September, 1977. 7 fig, 2 tab.

Descriptors: *Water purification, *Filters, *Boilers, *Pulp and paper industry, Electromagnetic waves, Steam, Water treatment, Industrial water, Boiler feed water, Cleaning, Filtration, Corrosion, Maintenance, Wisconsin, Foreign countries, Chemicals, Filtration, *Electromagnetic filters, *Paper mill condensates, Finland.

The sphere-matrix electromagnetic filter (EMF) is proven to be highly effective in purifying condensate. This filter (licensed to the Babcock and Wilcox Co. by Kraftwerk Union AG of W. Germany) consists of a pressure vessel of nonmagnetic material filled with magnetizable spheres and surrounded by a magnet coil and coil-cooling as-

sembly. Large magnetic gradients in the interstices between the spheres attract magnetic particles which collect on the spheres. The EMF provides increased boiler availability and efficiency, because the higher-quality feedwater results in cleaner internal heat transfer surfaces. With this filter the period between chemical cleaning of the boiler can be increased from once every 2-3 yr to once every 6 yr. The quantities of internal boiler water treatment chemicals are also reduced. The EMF has reduced maintenance of the zeolite softeners and reduced feedwater makeup. Favorable operating experiences are reported by Thiimany Pulp and Paper Co. (Kaukauna, Wisconsin) and Kyro Paper Mill (Kyroskoski, Finland). (DuVall-IPC)
W78-04094

SOLIDS CONTENT DETERMINATION OF SPENT SULFITE LIQUORS,
Cellulose Attisholz A.G., (Switzerland).
For primary bibliographic entry see Field 5A.
W78-04095

EVALUATION OF THE EFFECTIVENESS OF SEWAGE DEHELMINTHIZATION BY MECHANICAL PURIFICATION IN SMOLENSK, (IN RUSSIAN),
Regional Sanitation and Epidemiological Station, Smolensk (USSR).
S. Ya. Asnin, and L. S. Lagutina.
Med Parazitol Parazit Bolezni 45(5), p 609-611, 1976.

Descriptors: *Sewage treatment, Waste water treatment, *Dehelminthization, *Mechanical purification(Water), Ascarid eggs, *Trichurid eggs.

Unpurified sewage contained ascarid and trichurid eggs, an average of 5.7/1. Mechanical clearing provided only 50% dehelminthization. Sewage sediment contains an average of 60 eggs/kg. Keeping the sediment on irrigation fields for 2 yr did not dehelminthize it. Discharging sewage into water bodies and utilization in agriculture are epidemiologically dangerous.—Copyright 1978, Biological Abstracts, Inc.
W78-04096

COLOR REMOVAL IN KRAFT MILL WASTE-WATERS WITH MAGNESIUM,
British Columbia Univ., Vancouver.
W. K. Oldham, and R. J. Rush.
Journal Water Pollution Control Federation, Vol. 50, No. 1, January 1978, p 40-45, 2 fig, 5 tab, 7 ref.

Descriptors: Water pollution, Effluent, Waste water(Pollution), *Waste water treatment, Color, Pulp wastes, *Color removal, *Magnesium.

The chemical removal of color from pulp mill effluent is an objective of regulatory agencies in United States and Canada. The chemicals used in this study were reagent grade $\text{Ca}(\text{OH})_2$, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ and an anionic polymer. Results of the investigation showed conclusively that the addition of relatively small concentrations of Mg^{2+} can reduce substantially the amount of lime required to achieve a given level of color removal. The choice of which treatment scheme holds the most promise for full-scale use will depend on the relative economics of removing the required amount of color. (Chilton-ORNL)
W78-04111

TECHNOLOGICAL SYSTEMS OF THE DUNAUJVAROSI CORRUGATING MEDIUM MILL, PART 3. WATER MANAGEMENT (A DUNAUJVAROSI HULLAMVERTIKUM TECHNOLÓGIAI RENDSZEREI. 3. RESZ. VIZ-GAZDALKODAS),
M. Toth.
Papiripar, Vol. 21, No. 2, p 51-57, 1977. 6 fig, 3 ref.

Descriptors: *Waste water treatment, *Water treatment, *Sludge disposal, Wastes, Industrial wastes, Waste treatment, Water pollution treatment, Water pollution sources, Sludge, Pulp and paper industry, Effluents, Industrial water, Foreign countries, Europe, Discharge(Water), *Corrugating medium(Fluting paper) mills, Danube River, White water(Paper machines), Hungary, Fiber recovery.

Schematic descriptions are given of the corrugating medium (fluting paper) mill's water supply, process water treatment (precleaning), white water and brown waste water treatment, fiber recovery, sludge handling and disposal, and effluent discharge into the Danube River. (Brown-IPC)
W78-04137

LEARN MORE ABOUT VARIABLE SPEED PUMPING/2,
For primary bibliographic entry see Field 8C.
W78-04154

THE DISTRIBUTION OF HEAVY METALS IN ANAEROBIC DIGESTION,
Notre Dame Univ., IN.
For primary bibliographic entry see Field 5A.
W78-04190

CARBONATE PRECIPITATION FOR HEAVY METALS POLLUTANTS,
Illinois Inst. of Tech., Chicago.
J. W. Patterson, H. E. Allen, and J. J. Scala.
Journal Water Pollution Control Federation, December 1977, p 2397-2410. 17 fig, 10 tab, 6 ref.

Descriptors: *Water pollution, Pollutants, *Heavy metals, Wastes, *Waste water treatment, Nickel, Zinc, Cadmium, *Lead, Chemical precipitation, Carbonates.

Based upon the studies described, it was concluded that there is no benefit in using the carbonate system for zinc or nickel precipitation. Minimum soluble zinc concentrations achieved were approximately 0.25 mg/l at pH 9.5 and about 0.3 to 0.5 mg/l for nickel at pH 9.5 to 11. No advantage in denser sludges for better filtration was observed in the zinc or nickel carbonate systems over that for the corresponding hydroxide systems. Treatment nearly equivalent to that for cadmium hydroxide is obtained with cadmium carbonate. The cadmium carbonate system precipitate had relative filtrative rates approximately twice that of the cadmium hydroxide system. Treatment equivalent to that for lead hydroxide at pH 10.5 was obtained with lead carbonate at pH 7.5. The lead carbonate system yielded a denser precipitate than lead hydroxide with improved filterability characteristics. Treatment results for a solution containing all four metals were equivalent to those observed for the single-metal hydroxide and carbonate systems. (Chilton-ORNL)
W78-04191

SE. Ultimate Disposal Of Wastes

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES, PROCEEDINGS OF THE SECOND U.S.-JAPAN EXPERTS MEETING, OCTOBER 1976-TOKYO, JAPAN.
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5G.
W78-03735

CHEMICAL STABILIZATION OF SOFT SOILS,
Port and Harbour Research Inst., Kanagawa (Japan). Soil Stabilization Lab.
For primary bibliographic entry see Field 5G.
W78-03744

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

A METHOD FOR DISPOSING OF WASTE WATER AT DREDGED MATERIAL RECLAMATION SITES, Japan Dredging and Reclamation Engineering, Tokyo. E. Satoh.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 169-190. 3 tab, 13 fig.

Descriptors: *Landfills, Environmental engineering, *Dredging, *Turbidity, *Pollution control, *Methodology, *Waste water disposal, *Dehydration, *Suspended solids, Design, Waste treatment, Desilting, Waste water treatment, Spillways, Public health, Environmental control, Flocculation, *Land reclamation, *Dredge spoils.

This report introduces a method for disposing of the waste water that continuously flows in huge amounts from dredged materials as they are removed, transported, and dumped in reclamation sites. This method is characterized by its attempt to reduce the quantity of flocculants and to establish a stable and reliable system for disposal of large volumes of waste water by taking advantage of the natural conditions at the site to be reclaimed. The rectifying sedimentation pond method uses a flocculant. A stable and economic mass waste water disposal system is achieved by adjusting the amount of chemicals in proportion to the water quality and quantity flowing into the rectifying sedimentation pond. A trough spillway method of waste water purification is described which uses no flocculants. It is useful for reclaimed material that is not polluted. (See also W78-03735) (Katz)

W78-03745

LEGAL AND ADMINISTRATIVE ASPECTS OF BOTTOM SEDIMENT MANAGEMENT, Corvallis Environmental Research Lab., OR. For primary bibliographic entry see Field 5G.

W78-03746

SWINE LAGOON EFFLUENT ON A SOIL-PLANT ENVIRONMENT: AN IMPACT ASSESSMENT, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 5D.

W78-03755

LEACHATE PLUMES IN GROUND WATER FROM BABYLON AND ISLIP LANDFILLS, LONG ISLAND, NEW YORK, Geological Survey, Mineola, NY. Water Resources Div.

For primary bibliographic entry see Field 5B.

W78-03759

EVALUATION OF SCINTILLATION PROBE PROFILES FROM 200 AREA CRIB MONITORING WELLS, Atlantic Richfield Hanford Co., Richland, WA. Research Dept.

For primary bibliographic entry see Field 5B.

W78-03860

THE REPORT TO CONGRESS: WASTE DISPOSAL PRACTICES AND THEIR EFFECTS ON GROUND WATER: EXECUTIVE SUMMARY, Environmental Protection Agency, Washington, DC. Office of Water Supply.

For primary bibliographic entry see Field 5B.

W78-03864

DREDGE DISPOSAL STUDY, SAN FRANCISCO BAY AND ESTUARY. MAIN REPORT, Army Engineer District, San Francisco.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A037 727, Price codes: A06 in paper copy, A01 in microfiche. Army Corps of Engineers Main Report, February 1977. 121 p, 34 fig, 21 tab, 39 ref, 13 append.

Descriptors: *Dredging, *Waste disposal, *Estuaries, *Baseline studies, Water pollution, California, *Outer Continental Shelf, San Francisco Bay, Ocean dumping.

The basic concept of the overall study was to address to the greatest extent possible the mechanisms involved and the interrelationships of the various physical, chemical and biological parameters being influenced by the dredging activities. The study was set up to be problem specific and to San Francisco Bay, recognizing that it may have value to other areas. The first study category, dealing with dredging with open water disposal in the Bay, involves ten of thirteen study elements. These elements are: pollutant distribution, water column (characterize physical factors), oxygen sag, material release, biological community (characterize biota), crystalline matrix (characterize sediment chemistry), physical impact (relate physical and biological), pollutant uptake (relate chemical and biological), dredging technology (relate physical and equipment), and pollutant availability (integration of factors). The second study category deals with alternative disposal methods. The three study elements in this category are: land disposal, marsh development, and ocean disposal. (Sinha - OEIS)

W78-03875

PRELIMINARY REPORT ON IN SITU MEASUREMENTS OF THE EFFECTS OF SEWAGE DISCHARGE FROM NAVY SHIPS OPERATING WITHIN THE 12-MILE LIMIT, Naval Ship Research and Development Center Bethesda, MD.

A. Taitz, E. M. Stanley, T. H. Voisinet, and W. van Hees.

Available from the National Technical Information Service, Springfield, VA 22161 as AD- 908 992, Price codes: A03 in paper copy, A01 in microfiche. Preliminary Report No. 28-585, April 1973. 41 p, 17 fig, 10 tab, 6 ref.

Descriptors: *Dispersion, *Monitoring, *Sewage, *Water pollution sources, *Waste Water disposal, Ships, Virginia, Coliforms, *Outer Continental Shelf, Coastal zone.

The first of four planned field trials to be conducted as part of the study of the detectability and dispersion of sewage from Navy ships operating with the coastal zone is reported. The trial was conducted in the waters off Norfolk, Virginia, between 16 and 27 October 1972. Rhodamine WT was added to 5,000 gallons of untreated sewage to serve as a marker dye and for future dispersion modeling. This mixture was discharged from a stationary point source at approximately 10.5 miles off shore. Under these conditions, coliform bacteria in excess of background levels were detected by laboratory analysis of samples collected from the translocated and dispersed dye plume at greater than 7 hours after discharge. Other wastewater constituents in the sewage mixture could not be similarly detected, although this may in part be due to the low initial concentration of the waste. (Sinha - OEIS)

W78-03877

REMOTE SENSING OPERATIONS (MULTISPECTRAL SCANNER AND PHOTOGRAPHIC) IN THE NEW YORK BIGHT, SEPTEMBER 22, 1975, National Aeronautics and Space Administration, Langley Station, VA. Langley Research Center.

For primary bibliographic entry see Field 5B.

W78-03881

MARINE STUDIES OF SAN PEDRO, CALIFORNIA. PART II. POTENTIAL EFFECTS OF DREDGING ON THE BIOTA OF OUTER LOS ANGELES HARBOR. TOXICITY, BIOASSAY AND RECOLONIZATION STUDIES.

University of Southern California, Los Angeles. Allan Hancock Foundation; and University of Southern California, Los Angeles. Inst. of Marine and Coastal Studies.

For primary bibliographic entry see Field 5C.

W78-03882

METHANE FERMENTATION OF EXCESS ACTIVATED SLUDGE (PROBLEMATYKA FERMENTACJI METANOWEJ NADMIERNEGO OSADU CZYNNEGO),

For primary bibliographic entry see Field 5D.

W78-04092

TECHNOLOGICAL SYSTEMS OF THE DUNAJVAROS CORRUGATING MEDIUM MILL. PART 3. WATER MANAGEMENT (A DUNAJVAROSI HULLAMVERTIKUM TECHNOLÓGIAI RENDSZEREI. 3. RESZ. VIZ-GAZDALKODAS),

For primary bibliographic entry see Field 5D.

W78-04137

THE EFFECTS OF SEWAGE SLUDGE ON THE GROWTH RATE OF CARP, CYPRINUS CARPIO L., Chinese Univ. of Hong Kong. Dept. of Biology.

For primary bibliographic entry see Field 5C.

W78-04197

5F. Water Treatment and Quality Alteration

SOURCES OF EMERGENCY WATER SUPPLIES IN SANTA CLARA COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.

For primary bibliographic entry see Field 6D.

W78-03772

THE SAFE DRINKING WATER ACT: A DOLARS AND SENSE PERSPECTIVE, Ecdyne Corp., St. Paul, MN. Lindsay Div.

For primary bibliographic entry see Field 5G.

W78-03846

DRINKING WATER STANDARDS: PRINCIPLES AND HISTORY 1914 TO 1976, Environmental Protection Agency, Boston, MA. Water Supply Branch.

For primary bibliographic entry see Field 5G.

W78-03847

EVALUATION OF THE FLORIDA WATER SUPPLY PROGRAM.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 441, Price codes: A10 in paper copy, A01 in microfiche. 1973, 193 p, 7 append.

Descriptors: *Water supply, *Potable water, *Florida, *Water quality control, *Water treatment, Project planning, Water management(Applied), Water analysis, Evaluation, Legal aspects, Regulation, Bacteria, Budgeting, Reviews, Laboratories.

This study presents the findings, conclusions, and recommendations, with supporting data and explanatory text, resulting from EPA's evaluation of the Florida Water Supply Program. The study recommends improvements in the bacteriological surveillance program; improvement and expansion of the engineering surveillance of public water

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F—Water Treatment and Quality Alteration

supply systems; improved statutory authority for the Water Supply Program enforcement procedures; improved implementation procedures whereby responsibility for review and approval of plans and specifications would be separated from responsibility for engineering surveillance; improved water quality analysis capability; improved surveillance of small public water supplies; policies, guidelines and procedures for system design, operation, and surveillance be compiled and made available; an increase in the professional staff; expansion of the bacteriological and chemistry laboratory capability; the creation of two regional offices to facilitate surveillance activities; and preparation of a comprehensive inventory of all public and small public water systems. This evaluation assessed the present condition of public water supply operations, especially conditions relating to safety and reliability. The adequacy of the water supply program's legal basis, budget, manpower resources, regulations and policies, and surveillance activities were examined. The effectiveness of the program was interpreted in light of the condition of the state's supplies. (Nessa-NC) W78-03898

SYSTEM FOR NUMERICALLY RATING WATER SUPPLY SYSTEMS,

Hittman Associates, Inc., Columbia, MD.

J. P. Overman.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 321, Price codes: A13 in paper copy, A01 in microfiche. Prepared for the Water Supply Division, Office of Air and Water Programs, Environmental Protection Agency, Washington, D.C., February 1973, 280 p, 3 fig. 68-01-0193.

Descriptors: *Potable water, *Water quality, *Water quality control, *Water supply, Cities, Equipment, Data, Personnel, Legal aspects, Population, Reliability, *Federal Drinking Water Standards, *Urban water supply systems failure rate, *Rating system.

The study's purpose is to determine the feasibility of developing a rating system for predicting the ability of an urban water supply system to produce water consistently meeting the constituent limits of federal drinking water standards. The feasibility of the rating system was demonstrated by applying it to an existing water supply system. The rating concept is based upon determining the reliability of system equipment, the probability that the system furnishes water meeting federal drinking water standards, the effect of equipment failure on system water quality and the relative ability of the system to remove constituents from raw water that exceed the drinking water standards. In its present form the rating system is too complex to be practical for general application in the field. The concept requires simplification and preparation of a procedural type manual for field application. In developing a firm rating system, data should be analyzed to determine the probable effects of component failure on water quality, to develop a data bank of failure rate data for components, to determine and quantify effects of personnel skill levels on water quality, and to determine the effects of population, industrial environments, and legal controls on the reliability of water systems. (Nessa-NC) W78-03901

HEALTH SIGNIFICANCE OF KLEBSIELLA PNEUMONIAE IN DRINKING WATER EMANATING FROM REDWOOD TANKS,

Oregon State Univ., Corvallis. Water Resources Research Inst.

R. J. Seidler.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 355, Price codes: A05 in paper copy, A01 in microfiche. Report No. WRRI-54, October 1977, 81 p. OWRT A-038-ORE(1), 14-34-0001-7078.

Descriptors: Water quality, *Redwood tanks, Health problems, *Coliforms, *Potable water, *Public health, *Klebsiella pneumoniae, E. coli, Enterobacter, *Oregon, Water pollution, Water supply.

Ramifications of the presence of Klebsiella coliforms in drinking water emanating from redwood tanks are discussed. Results are presented of a field survey of 33 public and private water systems in Oregon which use drinking water stored in redwood tanks. During this survey some systems were found which exceed coliform limits some 10- to 40-fold and specific suggestions are offered to correct water supplies which are poorly designed. Cultural reactions are listed of Klebsiella and Enterobacter isolated from these drinking water systems and a survey of Klebsiella responses in conforming to the operational definition of a fecal coliform. A comparative study of virulence in mice is made using clinical and environmentally derived Klebsiella isolates. The health significance of oral ingestion of Klebsiella is quantitatively evaluated by determining the dosage levels in normal and stressed mice necessary to colonize the intestinal tract. The latter study derives its significance from human clinical reports which demonstrate a correlation between the presence of Klebsiella in the intestinal tract and a subsequent manifestation of a clinical infection. W78-03933

DECISIONS ABOUT WASTEWATER TECHNOLOGY: 1850-1932, Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of History, Technology, and Urban Affairs. For primary bibliographic entry see Field 5D. W78-03996

THE BACTERICIDAL ACTION OF FREE AND COMBINED CHLORINE WITH RESPECT TO THE REQUIREMENT OF THE SOVIET STATE STANDARD 2874-73 'DRINKING WATER', (IN RUSSIAN), Moskovskii Gosudarstvennyi Meditsinskii Inst. (I).

A. A. Semenova.
Gig Sanit 1, p 15-18, 1977.

Descriptors: *Water quality standards, *Potable water, Public health, E. coli, *USSR, *Bactericides, *Chlorine, Chlorination, Water treatment, Disinfection.

Experimental investigation data on the bactericidal (Escherichia coli) action of free and combined chlorine is presented. The period of contact and the amount of residual active chlorine necessary for safe disinfection and the water were determined. The effect of pH, temperature and initial contamination on the bactericidal action of free and combined chlorine was investigated. Copyright 1978, Biological Abstracts, Inc. W78-04054

IODINE TO CONTROL MICROBIOLOGICAL GROWTH IN FUEL STORAGE BASIN WATER, Allied Chemical Corp., Idaho Falls, ID. National Engineering Lab.

M. W. Wilding.
Available from the National Technical Information Service, Springfield, VA 22161 as ICP-1109, Price codes: A02 in paper copy, A01 in microfiche. Report ICP-1109, February 1977. 15 p, 9 fig, 2 tab, 9 ref. EY-76-C-07-1540.

Descriptors: Biocontrol, Bacteria, Algae, Storage tanks, Reservoir storage, Chlorine, *Iodine, *Microbial growth, *Water treatment, *Chlorination, Turbidity.

Water in the Fuel Storage Basin which consists of three 20-foot-deep basins connected by a canal had been treated with chlorine to prevent the growth of microorganisms. Chloride buildup in the

basins caused turbidity. Laboratory, pilot-scale and full-scale tests were performed using iodine as a biocide. Results of test indicated that iodine in concentrations greater than 0.75 ppm will effectively control the growth of bacteria. The iodine formed by reducing the iodine is readily reoxidized to iodine. The presence of iodine in these concentrations did not appreciably affect the visibility through the water. (Chilton-ORNL) W78-04108

PERMISSIBLE LEVELS OF MIGRATION OF CHEMICALS FROM PLASTICS INTO WATER, (IN RUSSIAN), Vesoyuzhny Nauchno-Issledovatel'skii Inst. Gigenii i Toksikologii Pestsitvidov, Kiev (USSR). For primary bibliographic entry see Field 5G. W78-04126

USE OF OPERATIVE INFORMATION ON SANITARY VIOLATIONS OF THE ENVIRONMENT, (IN RUSSIAN), Municipal Sanitary Epidemiology Station, Novokuznetskii (USSR). For primary bibliographic entry see Field 5C. W78-04188

5G. Water Quality Control

RELATIONSHIPS BETWEEN POTASSIUM PERMANGANATE TREATMENT AND WATER QUALITY,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.

C. S. Tucker, and C. E. Boyd.
Transactions of the American Fisheries Society, Vol 106, No 5, p 481-488, 1977. 14 ref, 9 tab, 3 fig. W78-04196

Descriptors: *Dissolved oxygen, *Potassium compounds, *Pesticides, *Fish diseases, *Pest control, *Water quality control, *Water treatment, *Biochemical oxygen demand, *Toxicity, *Aquatic bacteria, Aquaculture, Oxidation, Minnows, Sunfishes, Bacteria, Oxygen sag, *Potassium Permanganate.

The effect of potassium permanganate (KMnO₄) on some factors regulating dissolved oxygen concentrations in fish ponds was evaluated. Addition of 2,4, and 8 mg/liter KMnO₄ slightly decreased the chemical oxygen demand of pond water samples. Treatment of samples with 4 and 8 mg/liter KMnO₄ decreased the biochemical oxygen demand but did not prevent depletion of dissolved oxygen within the 4-day test period. Addition of 4 and 8 mg/liter KMnO₄ to water in plastic pools decreased phytoplankton abundance and gross photosynthesis and did not prove beneficial in increasing dissolved oxygen concentrations when oxygen concentrations were near 0 mg/liter. Potassium permanganate was also highly toxic to bacteria in laboratory studies. However, pond waters often contain large amounts of organic matter which express a KMnO₄ demand, rendering the chemical less effective as a bactericide. This implies that in treating bacterial fish diseases, enough KMnO₄ should be added to satisfy the KMnO₄ demand plus a bactericidal residual. The amount of KMnO₄ per application can be increased without harm to fish as toxicity to fish also decreased with increasing KMnO₄ demand. (Katz) W78-03707

FINAL REPORT: RESEARCH AND DEVELOPMENT ASSESSMENT ON SAFETY AND POLLUTION CONTROL FOR OUTER CONTINENTAL SHELF OPERATIONS, Harry Diamond Labs., Adelphi, MD.

M. F. Funke, and B. A. Weber.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A034 727, Price codes: A04 in paper copy, A01 in microfiche. Report No. HDL-TR-1780, December 1976. 51 p, 2 tab, 52 ref.

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WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Quality Control—Group 5G

Descriptors: Research and development, *Water pollution control, *Oil industry, *Exploration, *Safety, *Continental shelf, Equipment, *Technology, *Subsurface investigations, Methodology, On-site investigations, Oil fields, Oil wastes, Drilling, Offshore platforms, Evaluation, Environmental engineering, Transportation, Marine geology.

An investigation has been made of the research, development, and data gathering that would provide some of the tools, both information and hardware, that could be used to increase safety and decrease pollution hazards associated with offshore oil and gas exploration and production. Methods have been identified for reducing the dangers to which both workers and structures are exposed during drilling, subsurface production, and transportation operations. These dangers include fire and explosion, asphyxiation, blowout, pollution, and unsafe rig conditions. (Katz) W78-03720

ASSESSMENT OF EFFECTS OF ALTERED STREAM FLOW CHARACTERISTICS ON FISH AND WILDLIFE. TASK 3: ANALYSIS OF CASE STUDY FINDINGS, IDENTIFICATION OF PROBLEMS, AND RECOMMENDATION OF REMEDIES,

Enviro Control, Inc., Rockville, MD.
For primary bibliographic entry see Field 5C.
W78-03722

SETTLER'S CABIN PARK: ENVIRONMENTAL ASSESSMENT OF MINE DRAINAGE POLLUTION,

Ackenheil and Associates Geo Systems, Inc., Pittsburgh, PA.
W. E. Gooding, R. C. Witt, and M. T. Dougherty.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-261 593, Price codes: A05 in paper copy, A01 in microfiche. Report No. ARC 76-39-CO-4468 to Appalachian Regional Commission, Wash., D.C., August 1976. 86 p, 11 ref, 7 tab, 14 fig.

Descriptors: *Mine drainage, *Mine wastes, *Water pollution sources, *Water quality control, *Environmental engineering, *Pollution abatement, *Recreation facilities, Water pollution effects, Mine water, Water quality, Land reclamation, Mining, Land management, Pennsylvania, *Settler's Cabin Park(Penn).
W78-03736

A study was performed to document existing environmental constraints upon land and water resources in the Settler's Cabin Park and Pinkerton Run Watershed resulting from coal mining and mine drainage pollution. The findings show that mine drainage pollution has obviated beneficial use of the stream and that unclaimed strip mines and mine subsidence has discouraged aesthetic appreciation and recreation facilities development. A mine drainage abatement and land reclamation plan was developed based upon technical water quality criteria, cost effectiveness, land use planning and minimization of adverse impact upon the terrestrial ecosystem of Settler's Cabin Park. (Katz)
W78-03723

MANAGEMENT OF BOTTOM SEDIMENTS CONTAINING TOXIC SUBSTANCES, PROCEEDINGS OF THE SECOND U.S.-JAPAN EXPERTS MEETING, OCTOBER 1976—TOKYO, JAPAN.

Corvallis Environmental Research Lab., OR.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 684, Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Agency, Report No. EPA 600/3-77-083, July 1977, 295 p. Peterson, S.A. and K. K. Randolph, editors.

Descriptors: *Dredging, *Bottom sediments, *Metals, *Mercury, *Legal aspects, *Environmental engineering, Polychlorinated biphenyls, Water quality control, Public health, Benthos, Eutrophication, Toxicity, Oil, Oil pollution, Bays, Tokyo Bay, Seto Inland Sea(Japan), Osaka Bay, Hiroshima Bay, Minimata Bay, Methyl mercury, Sediment disposal.

Sixteen papers were presented at the Second U.S.-Japan Experts Meeting, Oct. 1976, Tokyo, Japan. The subject was the Management of Bottom Sediments Containing Toxic Substances. The removal of bottom sediments contaminated by organic wastes, methyl mercury, heavy metals, PCB's in estuaries and freshwater lakes were discussed. The effects on aquatic organisms as well as on the environments were discussed. Hydraulic dredging as a lake restoration technique was proposed. (See W78-03736 thru W78-03751) (Katz) W78-03735

DREDGING OF CONTAMINATED BED SEDIMENT IN JAPAN,

Ministry of Transport, Kobe (Japan). Bureau of Ports and Harbors.

R. Sameshima.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan, EPA-600/3-77-083, July 1977, p 1-19, 3 fig, 5 tab.

Descriptors: *Dredging, *Bottom sediments, *Metals, *Oil wastes, Cost allocation, Legal aspects, *Industrial wastes, Environmental engineering, *Polychlorinated biphenyls, *Water quality standards, Water quality control, Pollution abatement, Sediments, Costs, Legislation, Public health standards, *Japan.

The first dredging of contaminated bed sediment for the purpose of water pollution control was undertaken in 1958. In 1972-73 the problem of fish contamination was recognized and bed sediments were investigated all over the country. Concurrently, legal and administrative systems concerning pollution control were gradually formulated, and removal of contaminated bed sediments has been extensively undertaken. This paper discusses the progress of dredging, present status of dredging, and the legal and administrative issues concerning pollution control, especially the cost allocation system which has promoted pollution control efforts. (See also W78-03735) (Katz) W78-03735

COUNTERMEASURES FOR POLLUTION IN TOKYO BAY,

Ministry of Transport, Yokohama (Japan). Bureau of Port Construction.

T. Ohtsuka.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan, EPA-600/3-77-083, July 1977, p 20-61, 3 ref, 35 fig, 6 tab.

Descriptors: *Dredging, *Bottom sediments, *Eutrophication, *Phosphorous, *Anaerobic conditions, *Water pollution control, *Pollution abatement, Sludge, *Oxygen demand, Pollutants, *Metals, Environmental engineering, Sediments, Biodegradation, Benthos, Bays, Biochemical oxygen demand, Water quality, Oil, Mercury, Polychlorinated biphenyls, Cadmium, *Tokyo Bay(Japan), *Sludge removal.

Rapid industrialization and urbanization of Tokyo Bay has resulted in decreased quality of the resource. Eutrophication has resulted from the large quantity of organic matter produced endogenously in the Bay as well as from the surrounding land. Oxygen consumption by the bottom sludge produces anaerobic condition in the bottom layer which allows release of phosphorous in the

Bay. It is expected that removal of the accumulated sludge will improve the environment with subsequent increases in kind and number of benthos and crustaceans. Additional research on all aspects of bottom mud and water quality on the ecosystem is indicated. (See also W78-03735) (Katz) W78-03737

AN EXPERIMENT IN REMOVAL OF ORGANICALLY POLLUTED BOTTOM MUD FROM THE SETO INLAND SEA,

Nansei Regional Fisheries Research Lab., Hiroshima (Japan).

A. Murakami.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan, EPA-600/3-77-083, July 1977, p 62-88, 6 ref, 13 fig, 5 tab.

Descriptors: *Sludge disposal, *Bottom sediments, *Eutrophication, *Red tide, *Pollution abatement, Methodology, *Dredging, *Biochemical oxygen demand, Machinery, *Fishkill, *Environmental engineering, Nuisance algae, Water pollution, Water pollution control, Mud, Marine fisheries, Nitrogen, Phosphorous, Domestic wastes, Industrial wastes, Equipment, *Seto Inland Sea(Japan), Osaka Bay(Japan), Hiroshima Bay(Japan).

Organic pollution of bottom mud in the Seto Inland Sea was first identified in the 1950's and became a substantial problem in the 1970's with concentrated areas observed in Osaka Bay, Hiuchi Nada, Hiroshima Bay, and Beppu Bay. Bottom pollution is related to the harmful red tide which occurred in the Seto Inland Sea in the 1960's. Eutrophication in inshore waters contributes to the outbreak of the red tide, and the organically polluted bottom mud contributes to the eutrophication. Since 1973, the Fisheries Agency has been removing the polluted mud to reduce the eutrophication. The dredged mud is transferred to a treatment pontoon by a suction pipe. The mud is then treated through coagulation, sedimentation, and dehydration. Activated charcoal is used to filter the decant water which is then discharged to the sea. The settled sludge is hardened with cement and dumped in a land area. Work needs to be done on the method of removing newly deposited materials from the surface of polluted bottom muds. (See also W78-03735) (Katz) W78-03738

THE MECHANISM OF METHYLMERCURY ACCUMULATION IN FISH,

Tsukuba Univ., Ibaraki (Japan). Dept. of Environmental Epidemiology.

For primary bibliographic entry see Field 5B.

W78-03739

DETERMINATION OF TRACE AMOUNTS OF METHYLMERCURY IN SEA WATER,

Kumamoto Univ., (Japan). Dept. of Industrial Chemistry.

For primary bibliographic entry see Field 5A.

W78-03740

BEHAVIOR OF HEAVY METALS AND PCB'S IN DREDGING AND TREATING OF BOTTOM DEPOSITS,

Public Works Research Inst., Tokyo (Japan).

For primary bibliographic entry see Field 5B.

W78-03741

A STUDY ON THE BEHAVIOR OF MERCURY-CONTAMINATED SEDIMENTS IN MINAMATA BAY,

Japan Bottom Sediments Management Association, Tokyo.

For primary bibliographic entry see Field 5B.

W78-03742

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

USING SAND FILL TO COVER DREDGE SPOILS CONTAINING MERCURY, Kitakyushu Municipal Bureau of Port and Harbor, Fukuoka (Japan). S. Fujino.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 144-154. 2 ref, 2 tab, 9 fig.

Descriptors: *Dredging, *Water pollution control, *Soil stabilization, *Pollution abatement, *Mercury, *Path of pollutants, Methodology, *Impoundments, *Landfills, Feasibility, Water pollution control, Safety, Environmental engineering, Dusts, Methodology, Heavy metals, Metals, Public health, *Dredge spoils, *Dokai Bay(Japan), Bamboo nets method.

Bottom sediments contaminated with mercury were removed from Dokai Bay, Japan to a spoil area. Wind-borne dust from the dried spoil became a potential secondary pollution source. This paper reports on a project to cover the impounded spoil with a layer of sand one meter thick. Since the impounded spoil was too soft to allow the direct placement of the sand layer, the use of a 'bamboo-net method' was adopted after studying several alternatives. Rafts made of thick, long bamboos were placed on the mud and sheets of plastic were spread over them. A layer of sand and a layer of surface soil followed. This technique was verified as satisfactory in terms of economic feasibility, safety and pollution control. There was no influence on the periphery of the area due to exudation of pore water from the spoils. (See also W78-03735) (Katz) W78-03743

CHEMICAL STABILIZATION OF SOFT SOILS, Port and Harbour Research Inst., Kanagawa (Japan). Soil Stabilization Lab. T. Okumura.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 155-168, 6 ref, 11 fig, 2 tab.

Descriptors: *Landfills, Environmental engineering, *Soil stabilization, *Dredging, *Soil treatment, *Lime, *Asphalt, *Portland cements, Particle size, Public health, Environmental control, Soil chemistry, Cements, Pollution control, Reclaimed land, *Chemical stabilization, *Dredge spoils.

Chemical stabilization methods have recently been employed on reclaimed surface soils and in-situ soft clayey soils. Chemical stabilization is affected by the characteristics of the soil and the stabilizing agents. In this paper various kinds of chemical stabilizing agents are reviewed, stabilizing effects are considered, and the test results of comparisons of different stabilizers are shown. In conclusion, there is no single agent useful for all kinds of soil and stabilizing conditions. The commercial cost of some special additives makes them impractical, even though they add some degree of increased strength in the stabilization. It is much more reasonable, in practice, to increase the content of the simple stabilizing agents such as quick lime, hydrated lime, portland cement, and slag cement. (See also W78-03735) (Katz) W78-03744

A METHOD FOR DISPOSING OF WASTE WATER AT DREDGED MATERIAL RECLAMATION SITES, Japan Dredging and Reclamation Engineering, Tokyo. For primary bibliographic entry see Field 5E. W78-03745

LEGAL AND ADMINISTRATIVE ASPECTS OF BOTTOM SEDIMENT MANAGEMENT, Corvallis Environmental Research Lab., OR. A. F. Bartsch.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 191-201. 10 ref, 1 fig, 2 tab.

Descriptors: *Dredging, *Waste disposal, *Legislation, *Water quality control, *Pollution control, *Oceans, *Bottom sediments, *Federal Water Pollution Control Act, *Research and development, Public health, Water quality, Industrial wastes, Environmental control, Pacific Ocean, Atlantic Ocean, Sewage sludge, Heavy metals, Pesticides, *Marine protection, Research and Sanctuaries Act, *Dredge spoils.

Regulations currently control municipal and industrial wastes discharged through pipes and have done so for 50 years. Similar programs to control ocean dumping and dredge spoils in the United States are new. Sources potentially toxic sediments dumped in the oceans include industrial wastes, sewage sludge, construction and demolition debris, and dredge spoils. The Marine Protection, Research and Sanctuaries Act of 1972 attempts to regulate this dumping, research ways to end all ocean dumping and create marine sanctuaries. Additional legislation and current research on toxic substances in bottom sediments are presented. (See also W78-03735) (Katz) W78-03746

HYDRAULIC DREDGING AS A LAKE RESTORATION TECHNIQUE: PAST AND FUTURE, Corvallis Environmental Research Lab., OR. S. A. Peterson.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 202-228. 34 ref, 8 fig, 4 tab.

Descriptors: *Dredging, *Environmental effects, *Lakes, *Lake sediments, *Bottom sediments, *Temperature, *Water pollution control, *Benthos, *Water quality, Boating, Eutrophication, Habitats, Phosphorous, Standing crops, Biological communities, Oxygen, Michigan, Florida, Iowa, *Hydraulic mining, *Lake Lansing(Mich), *Clean lakes program, *Lake restoration, Storm Lake(Iowa), Trout Lake(Floria), Long Lake(Mich).

Hydraulic dredging in freshwater lakes has given rise to serious environmental concerns. Examples of past dredging projects are described and the paucity of factual data from the projects is pointed out. Lack of reliable data makes it difficult to predict the ecological effects of dredging freshwater lakes. Federal funding through the 'Clean Lakes Program' will be the impetus for new lake restoration dredging projects in the United States. Potential advantages and disadvantages of dredging lakes are addressed. Lake Lansing, Michigan provides an example of the type of dredging project which may be funded. Evaluation of these projects should provide answers to many of the environmental concerns associated with dredging. (See also W78-03735) (Katz) W78-03747

INTERCHANGE OF NUTRIENTS AND METALS BETWEEN SEDIMENTS AND WATER DURING DREDGED MATERIAL DISPOSAL IN COASTAL WATERS, Corvallis Environmental Research Lab., OR. For primary bibliographic entry see Field 5B. W78-03748

DREDGING CONDITIONS INFLUENCING THE UPTAKE OF HEAVY METALS BY ORGANISMS, Army Engineer District, San Francisco, CA. For primary bibliographic entry see Field 5B. W78-03749

DREDGED MATERIAL DENSIFICATION AND TREATMENT OF CONTAMINATED DREDGED MATERIAL, Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects Lab. C. C. Calhoun, Jr.

In: Management of Bottom Sediments Containing Toxic Substances: Proceedings of the Second U.S.-Japan Experts' Meeting—October 1976, Tokyo, Japan. EPA-600/3-77-083, July 1977, p 253-263. 3 tab, 2 fig.

Descriptors: *Dredging, *Waste treatment, *Drainage, Methodology, *Landfills, *Bottom sediments, *Research and development, *Flocculation, *Sludge treatment, *On-site investigation, Dissolved oxygen, Waste water treatment, Impoundments, Particle size, Vegetation effects, Oil wastes, *Densification, *Dredged spoils, *Riverine Utility Craft.

This paper describes work to develop methods for dredged material densification and treatment of contaminated dredged material. Densification techniques include conventional gravity drainage, mechanical agitation, electro-osmosis, crust management, aeration, frost action, wicks, and vegetation. With the exception of aeration and frost action, all techniques are being evaluated by large scale field tests. The applicability of various conventional wastewater treatment methods to dredged material is discussed. The extent of oil and grease contamination associated with confined disposal areas is reviewed as is the use of flocculants to improve the quality of effluents for confined containment areas. Field tests to determine the effectiveness of injecting oxygen and air into the pipeline during open-waist disposal to increase the dissolved oxygen in the water column are discussed as well as field tests to evaluate the ability of vegetation to remove contaminants for disposal area effluents. (See also W78-03735) (Katz) W78-03750

ARTIFICIAL-RECHARGE EXPERIMENTS NEAR LAKIN, WESTERN KANSAS, Geological Survey, Lawrence, KS. Water Resources Div.; and Kansas Water Resources Board, Topeka. For primary bibliographic entry see Field 4B. W78-03775

SOME ASPECTS OF THE PERSISTENCE AND FATE OF ACROLEIN HERBICIDE IN WATER, Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research. For primary bibliographic entry see Field 5B. W78-03817

THE PHASED CLEAN-UP PROGRAM, KANAWHA RIVER, E. N. Henry. Division of Water Resources, Department of Natural Resources, West Virginia. September 1974. 7 append.

Descriptors: *Kanawha River(WV), *Water pollution control, *Chemical industry, *Sewage treatment, *West Virginia, Rivers, Effluents, Industrial wastes, Sewage disposal, Waste treatment, Pollution abatement, Biochemical oxygen demand.

A phased water pollution abatement program begun in 1959 for the Kanawha River in West Virginia has resulted in improved control of chemical

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Quality Control—Group 5G

and sewage effluents, mainly without transferring costs to consumers. Chemical manufacturing increased greatly during World Wars I and II, and surveys in 1946-48 indicated serious pollution of the river from soluble chemical by-products and untreated sewage. Contamination was characterized by scums, oil streaks, and chemical odors, dissolved oxygen depletion during warm months due to bacterial breakdown of sewage and chemicals, and loss of all but coarse fishlife. Sewage and chemical wastes were essentially untreated. Sewage and chemical treatment standards were set in 1958; chemical plants were to reduce BOD5 by 40% (60% of a baseline discharge level set in 1959), reduce odors, and eliminate foams, scums, solids, and color from effluents. Primary sewage treatment requirements were extended to all cities. The Phase I deadline was set for June 1963; by that date nine primary sewage treatment plants, four industrial secondary treatment systems, and a joint municipal-industrial secondary treatment works were in operation. Phase II goals, including municipal secondary treatment and further industrial BOD5 reductions, were set for 1966, and the Phase III deadline was 1972. Municipal compliance was delayed in both phases, but industries made great progress. Appendices detail abatement efforts of Union Carbide, Monsanto, du Pont, and FMC Corporations. (Lynch-Wisconsin) W78-03821

LAKES AND PONDS,
Pennsylvania Univ., Philadelphia. Dept. of Land-
scape Architecture.
For primary bibliographic entry see Field 6B.
W78-03842

ALGAE HARVESTING FROM SEWAGE.
Caldwell Connell Engineers Pty. Ltd, Canberra
(Australia).
Environmental Study Report 1, 1976. 99 p, 18 fig,
20 tab, 13 ref.

Descriptors: *Harvesting of algae, *Algae,
*Sewage treatment, *Beneficial uses, *Nutrient
removal, Feeds, *Livestock, Ponds, Equipment,
Nutrients, Australia, Werribee(Australia),
Scenedesmus.

Algae for use in livestock feeding were harvested by filtration from shallow ponds receiving primary sewage treatment effluent, in experiments conducted in Werribee, Victoria, Australia in early 1975. Algae was found to be more practical and economical in deriving protein from sewage than bacteria, yeast, or fungi. Feeding trials with various livestock demonstrated that sewage-derived algae concentrate is comparable to soybean meal as a high-protein feed supplement. High-rate ponds are preferable to the normal, deeper waste stabilization ponds as toxic blue-green algae can be excluded and desirable green forms promoted; high-rate ponds are also more productive, occupy less space, and are amenable to industrial operation and control techniques. The 0.28-ha test pond received sewage effluent with an average BOD5 level of 405 mg/l and COD level of 733 mg/l. Maintenance of a pH of 8.3-9.0 through addition of lime favored larger, more easily-harvested Scenedesmus over the smaller Chlorella. Paper made of 40% pine kraft and 60% eucalypt kraft was a better filter than asbestos paper. A full-scale harvesting system would produce an effluent containing 15 mg/l suspended solids (91% removal for primary effluent), 20 mg/l total BOD5 (95%), 210 mg/l total COD (72%), 7.5 mg/l total nitrogen as N (83%), 0.5 mg/l ammonia nitrogen as N (98%), and 2.8 mg/l total phosphorus as PO4 (88%). (Lynch-Wisconsin) W78-03843

INVESTIGATION OF MINING RELATED POLLUTION REDUCTION ACTIVITIES AND ECONOMIC INCENTIVES IN THE MONONGAHELA RIVER BASIN,
Baker (Michael), Jr., Inc., Beaver, PA.

F. J. Doyle, C. Y. Chen, R. D. Malone, and J. R. Rapp.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-244 352, Price codes: A17 in paper copy, A01 in microfiche. Appalachian Regional Commission Agreement with Environmental Protection Agency, Office of Research and Development, April 1975. 384 p, 22 fig, 18 tab, 296 ref, 2 append. 14010 HQC-5, 72-89/RPC-707.

Descriptors: *Mining, *Coal mine wastes,
*Pollution abatement, *Beneficial use,
*Monongahela River Basin, Appalachian Mountain region, Rivers, River basins, West Virginia, Pennsylvania, Maryland, Acid mine drainage, Land reclamation, Revegetation, Landfill, Incentives, Industrial wastes, Acid mine water, Non-structural alternatives.

Mining-related pollution-reduction activities which private industry might profitably undertake in the Monongahela River Basin of West Virginia, Pennsylvania, and Maryland are identified and evaluated in this study. Economic incentives are discussed for environmental improvements in existing mining operations and abandoned mines; emphasis is placed on coal waste utilization. Conclusions include: (1) controlling surface water infiltration into underground mines is beneficial to coal mine operators when mine drainage discharges are moderate to highly acid; (2) a coal credit may be the only practical method for concurrent mine reclamation and recovery of remaining coal reserves; (3) combining abandoned mine land reclamation with removal of coal refuse piles is practical, and would be assisted by passage of the proposed Surface Mining Control and Reclamation Act of 1975; (4) prospects of reclamation and revegetation of mined lands for profitable timbering or pulpwood operations does not appear promising; (5) utilization of waste coal offers high economic potential with relatively high Btu content for power production; (6) coal mine waste can be used for landfill and embankment material; (7) raw coal waste and fly ash are suitable for manufacturing bricks and lightweight aggregate; and (8) alumina can be extracted economically from coal refuse. (Lynch-Wisconsin) W78-03844

**THE SAFE DRINKING WATER ACT: A DOL-
LARS AND SENSE PERSPECTIVE,**
Ecdyne Corp., St. Paul, MN. Lindsay Div.
D. D. Nowlin.
Water Conditioning, Vol. 19, No. 10, p 10-14,
December, 1977.

Descriptors: Water quality control, *Potable water, *Rural areas, Economics, *Water treatment, Public health, *Water quality standards, *Safe Drinking Water Act, Point-of-use water treatment.

The Safe Drinking Water Act (PL 93-523) gives the U. S. EPA the authority to set standards for water supply systems having more than 15 connections or serving more than 25 individuals. Estimates are that \$1.0-\$1.8 billion will need to be spent to achieve compliance with primary water quality regulations. Small towns and rural areas will be especially hard hit; the EPA calculates that \$200-\$237 per capita would be required to upgrade the average system of 100 users or less. The major cost problem is that small centralized systems would be treating all water delivered to users, while only a small portion of the treated water would actually be used for drinking and cooking. Economic considerations strongly favor point-of-use treatment as opposed to centralized treatment in the majority of such cases. Federal agencies are urged to take note to the point-of-use option as a cost-effective alternative to water quality improvement methods presently being considered. (Eberle-NWWA) W78-03846

**DRINKING WATER STANDARDS: PRIN-
CIPLES AND HISTORY 1914 TO 1976,**
Environmental Protection Agency, Boston, MA. Water Supply Branch.
F. B. Taylor.

Journal of the New England Water Works Assn., Vol. 91, No. 3, p 237-259, September, 1977. 7 tab, 13 ref.

Descriptors: *Potable water, Standards, Water quality control, Legislation, History, Public health, *Water quality standards, *Public Health Service Drinking Water Standards.

To understand the evolution of U. S. drinking water standards, one must start first with the National Quarantine Act of 1878. This act was major codification of the fairly old concept of legislation to control the spread of disease. By 1890, sections of revised quarantine acts were dealing specifically with protection against water-borne disease. The 1914 Treasury Standards for drinking water (known also as the first Public Health Service Drinking Water Standards) became the basis for all succeeding revisions of U. S. standards through 1974. Though the first standards prescribed limits on bacteria only, limits on various chemical constituents were added in later revisions as the need became apparent and as the technology for detecting these constituents became feasible. The National Interim Primary Drinking Water Standards effective last June extend these limits beyond interstate carrier systems to more than 240,000 community water supplies. Throughout the world, several basic principles have been applied in setting standards. These include (1) preventing the spread of disease, (2) aesthetic considerations, and (3) determining what degree of monitoring ability and compliance to a proposed standard is economically and technologically possible for community water supply systems. (Eberle-NWWA) W78-03847

**WATER CONSERVATION: DRAMATIC
CHANGES TAKING PLACE,**
Eutek, Inc., San Francisco, CA.
For primary bibliographic entry see Field 3E.
W78-03851

**REMOVING H2S FROM GEOTHERMAL
STEAM,**
Coury and Associates, Inc., Lakewood, CO.
G. E. Coury, and M. Vorum.
Chemical Engineering Progress, Vol 73, No 9, p 93-98, September, 1977. 4 fig, 4 tab, 6 ref.

Descriptors: *Thermal power, *Hydrogen sulfide, *Steam, Air pollution design criteria, Economics, Cooling towers, Ammonia, Sulfur compounds, Scrubbers, Fluid-bed reactors.

Hydrogen sulfide gas is one of the primary sources of air pollution associated with the utilization of geothermal steam for the production of electricity. Although H2S removal from various gaseous streams has been studied and practiced for many years, the geothermal application poses some unusual problems due to the temperature of the steam and the nature of geothermal turbines. In the process described in this paper, the H2S is absorbed in an aqueous solution of copper salts by precipitating copper sulfides. The copper is recovered from the precipitate by roasting in a fluid-bed reactor and is recycled to an absorber. The net products are the soluble sulfate and sulfite salts of ammonia. The process has also been designed to use part of the cooling tower blowdown as makeup water to dissolve the ammonium salts for disposal. The economics of the H2S removal process appear to be comparable to the relative cost of flue gas desulfurization systems for fossil-fuel fired boilers. (Eberle-NWWA) W78-03855

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

GROUND-WATER POLLUTION PROBLEMS IN THE SOUTHEASTERN UNITED STATES,
Geraghty and Miller, Inc., Port Washington, NY.
For primary bibliographic entry see Field 5B.
W78-03856

FORCES EXERTED BY WAVES ON A PIPELINE AT OR NEAR THE OCEAN BOTTOM,
California Univ., Berkeley. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 8B.
W78-03873

NATURAL HAZARD MANAGEMENT IN COASTAL AREAS,
Colorado Univ., Boulder. Inst. of Behavioral Science.
G. F. White, E. J. Baker, D. D. Baumann, and W. T. Chow.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 015, Price codes: A14 in paper copy, A01 in microfiche. Report to NOAA, Office of Coastal Zone Management, November 1976. 314 p, 22 fig, 4 append.

Descriptors: *Baseline studies, Hazards, Environmental effects, Hurricanes, Floods, Erosion, Landslides, Earthquakes, Coasts, Tsunamis, Management, Volcanoes, Avalanches, Subsidence, Outer Continental Shelf, Environmental impact, *Coastal Zone Management.

Coastal areas in the United States are afflicted with a distinctive array of natural hazards. Beach erosion is one, but along the coast problems of hurricane, tornado, flood, landslides, earthquake, tsunami, volcano, snow avalanche, and land subsidence are severe and may appear in different combinations. State management of coastal areas may be strengthened by giving implicit attention to these hazards. In turn, the information, planning, and management activity under coastal zone management may contribute to wiser adjustments to these growing hazards. Some state coastal zone programs reflect substantial awareness of and concern with natural hazards, either independent of or in concert with one or more Federal agencies. These efforts should be carefully examined by the coastal manager for their adequacy and for their relationship with the overall coastal zone management program. In other states, weak or inadequate efforts may demand significant upgrading or restructuring to reflect current technical knowledge, to enhance popular awareness, and to incorporate a hazard management component. (Sinha-OEIS)
W78-03879

MISSISSIPPI SOUND TEMPORAL AND SPACIAL DISTRIBUTION OF NUTRIENTS,
Gulf Coast Research Lab., Ocean Springs, MS.
For primary bibliographic entry see Field 5B.
W78-03880

WATER QUALITY EVALUATION OF DREDGED MATERIAL DISPOSAL FROM LOS ANGELES HARBOR,
University of Southern California, Los Angeles. Environmental Engineering Program.
For primary bibliographic entry see Field 5C.
W78-03889

MANPOWER AND TRAINING NEEDS OF STATE WATER POLLUTION CONTROL AGENCIES.
ABT Associates, Inc., Cambridge, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-253 370, Price codes: A06 in paper copy, A01 in microfiche. Prepared for Environmental Protection Agency, Washington, D.C., 1973, 129 p, 5 append.

Descriptors: *Water pollution control, *Manpower, *Personnel management, *Methodology, *Resource allocation, *Human resources, *Federal Water Pollution Control Act, Resources development, Administration, Education, Training, Planning, *1972 Federal Water Pollution Control Act Amendments, *Manpower requirements model, Workload indicators, *Manpower planning.

This study assesses the impacts of the 1972 Water Quality Act amendments in terms of the need for expanded personnel resources, or for training or retraining of personnel. The purpose of this report is: (1) to describe the methodology for development of staffing criteria for state water pollution control agencies; (2) to present the results of the study; (3) to identify and analyze problems encountered; and (4) to specify further actions which can be taken to provide management with full information on the human resource impacts of the Water Quality Act. This study represents a first step toward the development of occupation definitions and staffing guides for state water pollution control agencies. These will permit program managers to translate estimated program workloads into both quantitative and qualitative manpower requirements. Once these staffing criteria have been developed and validated, they will form the basis for a predictive model for determining state agency manpower requirements. This model will specify the functions which must be performed by state water pollution control agencies and will enable the user to determine the manpower requirements for each function on the basis of the size of a workload indicator for that function. This research is aimed at the creation of a federal-state-local manpower planning system. (Nessa-NC)
W78-03890

ROCKY MOUNTAIN ENVIRONMENTAL RESEARCH: QUEST FOR A FUTURE PROBLEMS AND RESEARCH PRIORITIES IN THE ROCKY MOUNTAIN REGION.

Eisenhower Consortium for Western Environmental Forestry Research, Fort Collins, CO.
For primary bibliographic entry see Field 6B.
W78-03897

EVALUATION OF THE FLORIDA WATER SUPPLY PROGRAM.

For primary bibliographic entry see Field 5F.
W78-03898

ENERGY DEVELOPMENT AND LAND USE IN TEXAS,

Texas Transportation Inst., College Station.
For primary bibliographic entry see Field 3E.
W78-03900

SYSTEM FOR NUMERICALLY RATING WATER SUPPLY SYSTEMS,

Hittman Associates, Inc., Columbia, MD.
For primary bibliographic entry see Field 5F.
W78-03901

CLASSIFICATION OF AMERICAN CITIES FOR CASE STUDY ANALYSIS: VOLUME I. SUMMARY REPORT,

Urban Systems Research and Engineering, Inc., Cambridge, MA.
For primary bibliographic entry see Field 6A.
W78-03918

COAL WASTE STABILIZATION BY ENHANCED VEGETATION,

Bureau of Mines, Washington, DC.
J. P. Capp, D. K. Gilmore, and D. G. Simpson.
Available from the National Technical Information Service, Springfield, VA 22161 as CONF-7505105-1, Price codes: A02 in paper copy, A01 in

microfiche. In: Reports of the Polish-U.S. Symposium, 'Environmental Protection of Openpit Coal Mines.' Denver, Colo., May 27-29, 1975, p. 125-136.

Descriptors: *Coal mine wastes, *Coal mines, *Strip mine wastes, *Fly ash, *Reclamation, *Land reclamation, *Vegetation, Establishment, *Slope stabilization, *Stabilization, *Soil stabilization, Mine wastes, Wastes, Industrial wastes, Water pollution sources, Mine acids.

Coal wastes generated by previously uncontrolled surface mining and dumping of preparation plant refuse continue to cause environmental and aesthetic problems. One potential method of treatment developed by the United States Bureau of Mines employs powerplant fly ash as a soil-building amendment. Application of tonnage quantities of fly ash has resulted in successful revegetations of experimental sites totaling 83 acres of orphaned surface mines and 59 acres of refuse material. Costs include regrading, mixing of ash and spoil, seeding, fertilizing and mulching, but are highly dependent upon haulage of fly ash. (Katz)
W78-03952

CHEMICAL AND BIOLOGICAL STUDIES ASSOCIATED WITH THE RECOVERY OF THE RIVER EBBW FAIR (1970-74),

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology. R. Williams.
Water Pollution Control, Vol. 75, No. 4, p. 428-444, 1976. 5 fig, 10 tab, 23 ref.

Descriptors: *Water quality, Water pollution, *Water pollution effects, *Water pollution control, *Water pollution sources, *Pollution abatement, *Water chemistry, *Industrial wastes, *Water pollution treatment, *Effluents, Aquatic environment, Monitoring, Biological communities, Environmental effects, Toxicity, Population, Fish populations, *Ebbw Fair River(Wales), LC 50, Steel works.

The Ebbw River System has been subject to pollution by steelwork's effluent since the 1930's. A treatment plant constructed to treat the steelwork's discharge became operational in 1971 and achieved satisfactory effluent standards by mid-1973. The present paper presents studies on the changes in river chemistry and biology during the period 1970-74. In terms of water chemistry, improvements were noted in pH and suspended solids levels while suspended coal residues remained a problem. Plant populations were seen to make significant headway in recolonizing the polluted regions, while macroinvertebrates and fish were much less successful, owing at least partially, to their reliance on an established plant community. (Katz)
W78-03953

THE JAPANESE REGIONAL WASTEWATER TREATMENT SYSTEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering; and Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5D.
W78-03969

TEMPERATURE CRITERIA FOR FRESHWATER FISH: PROTOCOL AND PROCEDURES,

Environmental Research Lab.-Duluth, MN.
W. A. Brungs, and B. R. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-270 032, Price codes: A07 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA-600/3-77-061, May 1977, 129 p, 25 tab, 8 fig, 129 ref.

Descriptors: Freshwater fish, Water quality, Water pollution effects, *Temperature, Growth,

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Quality Control—Group 5G

Reproduction, *Standards, Mortality, Water pollution, *Thermal pollution, Thermal power, Thermal power plants, *Thermal stress, *Thermal water, Methodology, Laboratory tests, *Water quality criteria, *Water quality standards, *Temperature requirements, Standards development, Numerical criteria.

The evolution of freshwater temperature criteria is discussed as it relates to standards development by regulatory agencies. The present, generally accepted philosophical approach to criteria development is explained in detail and its use to protect various life stages of fish is demonstrated by selected examples. Numerical criteria for survival, spawning, embryo development, growth, and gamete maturation of fish species were calculated and tabulated. (Katz)

W78-03976

DERIVATION OF RESIDUAL COEFFICIENTS FOR TYPICAL INDUSTRIES IN NEW ENGLAND,

Center for the Environment and Man, Inc., Hartford, CT.

H. D. Mlynarski, and G. M. Northrop.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-258 996, Price codes: A07 in paper copy, A01 in microfiche. Final Report from Phase 2 of the Study of the Impact of Economic Development and Land Utilization Policies on the Quality of the Environment, with Initial Application to New England. Report No NSF-RA-E-75-159, October 1975. 151 p.

Descriptors: *Pollution abatement, *Residual coefficients, *New England, *Environmental impacts, *Mathematical models, *Regional planning, *Economic development, Land use, *Industries, Polluting activities.

This report contains a summary of the residual coefficients used in the Residual General Model to convert population, employment, and other measures of economic activity to an annual amount of pollutants. The report serves two functions: (1) it tersely summarizes an extensive set of residual coefficients; and (2) it presents their derivation and source documentation in a consistent manner. These Residual Coefficients are the multipliers used to calculate annual amounts of polluting residuals. The objective of this effort is to provide a clear description of the methodology and source documents used in the compilation of these coefficients in order to furnish a framework through which similar data might be applied to other regions. Included are: revised residual coefficients matrix and explanatory items; explanation of the methodology used to determine the residual coefficients for each of the 85 designated polluting activities; problems involved in computing residual coefficients; and a listing of source documents cited. (Bell-Cornell)

W78-03988

EFFLUENT STANDARDS—EFFECT UPON DESIGN,

Los Angeles Bureau of Sanitation, CA.

W. F. Garber.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 103, No 106, p 1113-1127, December 1977. 1 fig, 4 tab, 8 ref.

Descriptors: *Water quality, *Environmental impact statements, *Water standards, *Effluents, Design practices, Toxicity, Toxicology, Legislation, Water treatment, California, Wastewaters, Trace metals, Ocean waters, Chlorinated hydrocarbons.

Factors including a goal of ultimate exclusion of the use of the waters of the United States for the disposal of pollutants, limited knowledge of actual toxicity limits, problems with accurate analytical methods, little knowledge of uncontrollable

background, and zealot pressures on legislatures have led to overly conservative standards. These requirements with unrealistic design and construction deadlines have left the designer little choice but to design for compliance with numbers shown in the standards rather than the least net negative environmental impact. After the mandates of the present laws are met, the energy use to achieve 'higher standards' will lead to a poorer overall land, air, and water environment. Assurance that environmental improvement will accrue is therefore directly dependent upon scientifically valid effluent and receiving water standards and it is of considerable importance that research be carried out in this area. (Bell-Cornell)

W78-03991

HIGH-RATE DISINFECTION: CHLORINE VERSUS CHLORINE DIOXIDE,

O'Brien and Gere Engineers, Inc., Syracuse, NY. For primary bibliographic entry see Field 5D.

W78-03992

PRINCIPLES FOR WATER QUALITY MANAGEMENT,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Engineering.

D. A. Okun.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 103, No 106, p 1039-1055, December 1977. 1 tab, 26 ref.

Descriptors: *Water quality, *Regional development, *Water management(Applied), *Regions, Water costs, Potable water, Water resources, Water supply, Water projects, Economics of scale, Efficiencies, Financing, United States.

On April 1, 1974 there were created in England and Wales 10 water authorities which were given the responsibility for the ownership, planning, design, construction, operation and financing of facilities for water supply, water pollution control, water-based recreation, flood prevention, fisheries, and inland navigation. Study of the process of this revolutionary reorganization led to the development of five principles for sound water quality management that might guide practice in the United States: (1) every water project is unique and should be treated as so; (2) efficiencies and economies of scale should be exploited; (3) the costs should be met by those who benefit; (4) potable water should be drawn from protected rather than polluted sources; and (5) the management of water supply and water pollution control should be integrated. Regionalization is the key to following these principles, and interest in regionalization is already being expressed in the United States. Many approaches to regionalization can be followed, according to local circumstances. (Bell-Cornell)

W78-03993

LAGUNA DE BAY WATER RESOURCES DEVELOPMENT,

Bureau of Experts, Sogreah, Grenoble, France.

E. Pariset.

Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 103, No 106, p 1021-1038, December 1977. 7 fig, 2 tab, append.

Descriptors: *Water resources development, *Water supply, *Water pollution, *Flood control, *Water management(Applied), Dams(Concrete), Algae, Water quality, Spillways, Sewage disposal, *Philippines, Bays, Water programs, Optimum development plans, Limnology, *Lake regulation, Mathematical models.

A comprehensive program for the water management of Laguna de Bay, a 900-km² shallow brackish lake in the Philippines, has been studied. Hydrology was analyzed and the construction of

two dams recommended to protect Manila against floods and to control the lake. The water quality and main limnological aspects were established with the help of a specially built laboratory. The main problem presently is the excessive proliferation of algae triggered by the excess of nutrients, mainly nitrates, in the lake. Main uses of water were evaluated, fish raising, irrigation, and water supply including operation of an 8-m³/hr pilot plant and the corresponding water quality criteria. A first approach of the pollution control program needed in order to obtain results was completed and the economic interest for the community ascertained. Recommendations were made for the institutional organization and the mode of financing without which the best program remains inapplicable. (Bell-Cornell)

W78-03994

THE BACTERICIDAL ACTION OF FREE AND COMBINED CHLORINE WITH RESPECT TO THE REQUIREMENT OF THE SOVIET STATE STANDARD 2874-73 'DRINKING WATER', (IN RUSSIAN),

Moskovskii Gosudarstvennyi Meditsinskii Inst. (I).

For primary bibliographic entry see Field 5F.

W78-04054

ESTIMATE OF COSTS FOR WATER POLLUTION CONTROL MEASURES IN THE PULP AND PAPER INDUSTRY,

Department of the Environment, Ottawa (Ontario). Water Pollution Control Directorate. Environmental Protection Service, Economic and Technical Review, Report EPS 3-WP-77-11, 30 p. September, 1977. 9 tab, append.

Descriptors: *Costs, *Water pollution control, *Pulp and paper industry, *Canada, Foreign countries, Water pollution treatment, Waste water treatment, Economics, Wastes, Industrial wastes, Water pollution sources, Legislation, Capital costs, Operating costs.

This report presents projected estimates of the capital and operating costs that will be incurred by the Canadian pulp and paper industry in complying with the federal pulp and paper effluent regulations. Of the total of 157 mills assessed, 62 were deemed to be in compliance with the regulations, including 28 mills discharging to municipal sewers. The capital cost of pollution control facilities for the mills not in compliance has been projected to be \$1,034 million. Annual operating cost of these facilities for all mills have been projected to be \$34.3 million. The cost data presented are considered accurate in relation to the various production categories of the pulp and paper industry, and relevant to the industry as a whole. The method used in compiling these data is outlined, as well as inherent limitations. (Witt-IPC)

W78-04067

THE SELF-PURIFICATION OF UNDERGROUND WATERS, (IN RUSSIAN),

Belorussian Sanitary-Hygienic Research Inst., Minsk (USSR).

For primary bibliographic entry see Field 5B.

W78-04076

PROTECTION OF WATERS FROM CONTAMINATION WITH PESTICIDES AND MINERAL FERTILIZERS: STUDIES OF 1971-1975, (IN RUSSIAN),

Kharkov Vodokanalniiproekt Inst. (USSR).

N. N. Dykhanov, and I. D. Pichakhchi.

Gidrobiol Zh 13(1), p 14-27, 1977.

Descriptors: *Water pollution control, *Pesticides, *Mineral fertilizers, Fertilizers, Pesticide residues, *USSR.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Results are presented of complex studies performed by the research institutes of the USSR during 1971-1975 concerning surface water protection from contamination with remnants of mineral fertilizers and pesticides drifted by runoff from the farming lands. Promising trends of the further research in this field are discussed.—Copyright 1978, Biological Abstracts, Inc.

W78-04078

MEASURING THE COST OF INDUSTRIAL WATER POLLUTION CONTROL,

B. A. Gelb, and J. G. Myers.

Conference Board Inc., New York, N.Y., Report No. 700, 92 p, 1976. 6 charts, 19 ref, 25 tab.

Descriptors: *Costs, *Water pollution control, *Industrial wastes, United States, Waste water treatment, Water pollution sources, Steel, Oil, Pulp and paper industry, Chemical industry, Legislation, Water quality act, Pollution abatement, Alkalais(Bases), Chlorine, Oil industry.

An overview of the procedure used for measuring the costs of industrial water pollution abatement is presented, and a summary is given of the findings and cost projections resulting from detailed case studies of 5 manufacturing industries, including pulp and paper, alkali-chlorine, industrial and organic chemicals, petroleum refining, and steel. The impact of the 1972 amendments to the U.S. water quality regulations is clearly indicated. A glossary of terms is appended. (Brown-IPC)

W78-04079

THE SIGNIFICANCE OF THE (GERMAN) WASTEWATER DISCHARGE TAX LAW AND ITS FEE-COMPUTING FORMULA FOR THE PULP INDUSTRY (DIE BEDEUTUNG DES ABWASSERABGABEGESETZES NACH MASSGABE DER BEMESSUNGSSFORMEL FÜR DIE ZELLSTOFFINDUSTRIE),

Papierwerke Waldhof-Aschaffenburg A. G., Raubling (West Germany).

K. Hoch.

Muenchner Beitraege Abwasser Fischerei Flussbiologie, Vol. 27, p 59-70, 1977. 7 fig, 1 tab.

Descriptors: *Legislation, Pulp and paper industry, *Effluents, Water pollution, Biochemical oxygen demand, Foreign countries, Water pollution sources, Wastes, Industrial wastes, *Pulp wastes, Taxes, *Pollution taxes(Charges), *Germany(Water pollution taxes).

Data are reviewed concerning the production, size, and regional distribution of West German pulp mills; the effluent discharge loads (BOD and COD) of the main processing stages involved in pulp manufacture; and factors affecting the effluent load levels of the German pulp industry (currently 250-550 kg of 5-day BOD/ton of pulp). Attainable reductions in these load levels are examined from their technical and economic angles. It is concluded that at least 3 years should be allowed for the development of the desired efficiencies in available pollution-abatement technologies, plus 5 years for practical realization of necessary mill modernizations (or shut-downs). In addition, international agreements are needed not only on standardization of toxicity parameters (in view of rivers traversing national boundaries) but also on financing aids to necessary capital investments. (Speckhard-IPC)

W78-04082

PULP AND PAPER MANUFACTURE: ENERGY CONSERVATION AND POLLUTION PREVENTION,

Noyes Data Corp., Park Ridge, NJ.

For primary bibliographic entry see Field 5D.

W78-04084

AN ANALYSIS OF BOD AND COD IN THE STONE GROUNDWOOD PROCESS,

Technische Univ. Darmstadt (West Germany).

Inst. fuer Paper-fabrikation.

For primary bibliographic entry see Field 5A.

W78-04089

REFINER PULP MILL EFFLUENT,

New Zealand Forest Service, Rotorua.

For primary bibliographic entry see Field 5B.

W78-04091

IN-PLANT TECHNOLOGY FOR THE PREVENTION OF AIR AND WATER POLLUTION (ZAKŁADOWE TECHNOLOGIE ZAPOBIĘGANIA ZANIECZYSZCZANIU

POWIĘTRZA I WODY),

IVL-Consulting Ltd., Goeteborg (Sweden).

G. Wernquist.

Przegląd Papierniczy, Vol. 33, No. 5, p 182-185, May, 1977. 8 fig, 1 tab.

Descriptors: *Pulp and paper industry, *Water pollution control, *Air pollution, Pulp wastes, Waste water treatment, Wastes, Industrial wastes, Water pollution sources, Water reuse, Recycling, Ion exchange, Pollution control, Bleaching wastes, Water pollution control, Water purification, Foreign countries, Europe, *Sweden, Condensates, Closed systems.

Recent technology aimed at preventing water and air pollution, developed by the Swedish pulp and paper industry, made it possible to reduce the pollution level to that of about 50 years ago, although production during this period increased nearly ten-fold. Discussed are closed-circuit pulp screening and purification of condensate which, along with dry barking and an improved pulp washing method, resulted in a nearly completely closed system in a modern mill up to the bleaching stage. Presently, bleaching is responsible for nearly 70% of mill-caused pollution, and efforts are being made to develop suitable processes for the purification of bleach plant effluents. Methods aimed at the reduction of pollution include prolonged delignification (cooking) before bleaching, oxygen bleaching, recycling of bleach plant effluents to evaporators and kraft digesters, and waste water purification, e.g., by means of ion-exchangers. Reduction of air pollution is presently achieved by the use of electrofilters. The advantages and drawbacks of this process are indicated. (Stapinski-IPC)

W78-04093

RECLAMATION OF POLLUTED FARM PONDS,

Louisiana Tech Univ., Ruston. Dept. of Agricultural Engineering.

J. W. D. Robbins, and J. D. Nelson.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 807, Price codes: A04 in paper copy, A01 in microfiche. Louisiana Water Resources Research Institute, Baton Rouge, Completion Report, July 1977. 47 p, 4 fig, 22 ref, 7 append. OWRT B-008-LA(2).

Descriptors: *Eutrophication, *Lake restoration, *Nutrient inactivation, *Sediment sealing, *Farm ponds, *Water quality, Nutrient cycling, Clay soils, Aquatic ecology, Lakes, Reservoirs, Impoundments, Nutrients, Pollutants, Water pollution control.

The objective was to determine if application of clay soils to nutrient-rich pond water could be effective in reclaiming the usefulness of eutrophic farm ponds. Clay particles were to serve as a nutrient inactivator and bottom sediment sealant. Pond water was isolated (in situ) with polyethylene columns. Three clay soil types were used at three application rates on four sites of 12 columns each within the pond-nine columns for the different treatments and three control columns. Three sites

were treated in July and the fourth site was treated in February. Water samples were taken from the columns and the pond before and after treatment. Samples were analyzed for various water quality parameters to determine the effectiveness of each treatment. Laboratory results indicated that under the experimental conditions of this study, application of clay soil within columns in the summer did not effectively reduce productivity or limit nutrient availability. Visual observations of pond productivity indicated that treatment in winter was more effective. It is suggested that clay should not be eliminated from consideration as a nutrient inactivator, but further study should be initiated to determine the effects of season of treatment.

W78-04098

RUNOFF POLLUTION FROM MULTIPLE FAMILY HOUSING,

Rutgers - The State Univ., New Brunswick, NJ.

Water Resources Research Inst.

For primary bibliographic entry see Field 5B.

W78-04102

IODINE TO CONTROL MICROBIOLOGICAL GROWTH IN FUEL STORAGE BASIN WATER,

Allied Chemical Corp., Idaho Falls, ID. National Engineering Lab.

For primary bibliographic entry see Field 5F.

W78-04108

GREAT LAKES WATERS: RADIATION DOSE COMMITMENTS, POTENTIAL HEALTH EFFECTS, AND COST-BENEFIT CONSIDERATIONS,

Argonne National Lab., IL.

E. J. Ainsworth, T. B. Borak, D. N. Edgington, W. E. Kiesleski, and T. L. Winters.

Available from the National Technical Information Service, Springfield, VA 22161 as ANL/ES-58, Price codes: A04 in paper copy, A01 in microfiche. Report ANL/ES-58, July 1977, 50 p, 16 tab, 33 ref, append. W-31-109-Eng-38.

Descriptors: *Water quality, *Radioactivity, *Great Lakes, *Cost-benefit analysis, Radioisotopes, Standards, Water quality standards, Environmental effects, Dose commitment.

A Great Lakes Water Quality Agreement was signed by the United States and Canadian Governments in 1972 which concerned nondegradation of Great Lakes waters and maintenance of low levels of radioactivity and other pollutants. The agreement proposed an objective of one millirem radioactivity. Data presented show that current levels of radioactivity in the Great Lakes waters result in dose commitments in excess of 1 mrem for whole body and 6 mrem for bone. Doses to man resulting from ingestion of the water are not expected to decline by 2050. Cost-benefit considerations support a policy of removal of Ra226 and Sr90 through treatment of water before ingestion. Adoption of the water-quality radioactivity objective of one millirem is stated to be premature and adoption should be delayed until the radioactivity levels are established more accurately. (Chilton-ORNL)

W78-04109

A STUDY OF THE SEABOB, XIPHOPENEUS KROYERI (HELLER) IN LOUISIANA,

Louisiana Wildlife and Fisheries Commission, New Orleans. Seafood Div.

C. L. Juneau, Jr.

Technical Bulletin No. 24, September 1977, 24 p, 8 fig, 15 tab, 24 ref.

Descriptors: Management, *Fish management, *Shrimp, *Louisiana, Coasts, Breeding, *Commercial fishing, Commercial shellfish, *Seabobs.

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WATER RESOURCES PLANNING—Field 6

Techniques Of Planning—Group 6A

Sampling conducted along coastal areas west of the Mississippi River from October 1974 through September 1976 indicated that catch per effort for seabobs was higher in late summer and early fall again in late winter. Biological, climatological, and hydrological data were also gathered throughout the period of investigation. It was found that seabobs usually congregate near beaches and around the mouths of rivers and passes after the passage of a cold front. Recommended management practices for the utilization of seabobs without detriment to other species included: (1) allowing trawling only in areas known not to over-winter white shrimp; (2) allowing trawling only within a certain distance from the beach; (where white shrimp do not usually overwinter); (3) allowing trawling in all areas but enforce a count law on white shrimp; (4) allowing trawling in all areas without count law but permitting only a small percentage of shrimp species other than seabobs. (Chilton-ORNL) W78-04116

1977 ENVIRONMENTAL CONDITIONS RELATIVE TO SHRIMP PRODUCTION IN COASTAL LOUISIANA ALONG WITH SHRIMP CATCH DATA FOR THE GULF OF MEXICO, Louisiana Wildlife and Fisheries Commission, New Orleans. Seafood Div. B. B. Barrett, and E. J. Ralph. Technical Bulletin No 26, December 1977. 16 p, 7 fig, 12 tab, 14 ref.

Descriptors: *Environmental effects, *Shrimp, *Salinity, *Temperature, Population, *Louisiana, *Gulf of Mexico, Commercial fishing, Brown shrimp.

The average per annum Gulf shrimp catch for the period 1965-1975 was 127 million pounds (heads off), valued at an annual average of \$121 million dockside. 58% of these were brown shrimp, 27% white, 13% pink and 2% royal reds, rock shrimp, and seabobs. There has been an apparent trend over the past ten years toward increased catches of brown shrimp. Examination of environmental parameters over the past twenty years indicated that changes in salinities and temperatures in nursery areas may be a factor in increased brown shrimp populations. (Chilton-ORNL) W78-04117

PERMISSIBLE LEVELS OF MIGRATION OF CHEMICALS FROM PLASTICS INTO WATER, (IN RUSSIAN), Vsesoyuzny Nauchno-Issledovatel'skii Inst. Gigenii i Toksikologii Pestitsvidov, Kiev (USSR). V. O. Sheftel. Gig Sanit 10, p 88-90, 1976.

Descriptors: *Water pollution standards, *Lethal limit, *Chemical wastes, *Plastics, *Potable water, Public health, Organic compounds, *Acetates, *Phthalates, *Titan, *Zinc.

The permissible level of migration (PLM) of harmful substances from plastics into water is not a standard for drinking water quality, but a criterion for the preliminary hygienic inspection of the use of polymeric materials in water supply systems. This study was conducted by laboratory methods under model conditions. For substances whose migration level is 2-3 orders lower than the threshold of their unfavorable effect on water quality, the release from plastics need not be standardized. When the maximum permissible concentrations of substances have been established according to organoleptic and sanitary-toxicological indices, analogous values may be used as the PLM. The PLM of some substances (e.g., butylacetate, dibutylphthalate, diisopropylphthalate, titan, Zn) may differ somewhat from their maximum permissible concentrations as a result of the criteria used to substantiate these values. (Copy-right 1978, Biological Abstracts, Inc.) W78-04126

IDAHO WATER SUPPLY PROGRAM. Environmental Protection Agency, Seattle, WA. Air and Water Programs Div. For primary bibliographic entry see Field 6D. W78-04147

ENVIRONMENTAL IMPACTS OF THE GENERATION OF ELECTRICITY IN THE PACIFIC NORTHWEST, VOLUME II. Equitable Environmental Health, Inc., Woodbury, NY. For primary bibliographic entry see Field 6G. W78-04149

ON THE RECOVERY OF PERTURBED ECOSYSTEMS, California Univ., Santa Barbara. Dept. of Biological Sciences. For primary bibliographic entry see Field 5C. W78-04160

POWER PLANT CHLORINATION: REGULATORY CONSIDERATIONS, Michigan Water Resources Commission, East Lansing. For primary bibliographic entry see Field 5C. W78-04173

CONTROL OF NONPOINT WATER POLLUTION FROM AGRICULTURE: SOME CONCEPTS, Agricultural Research Service, Chickasha, OK. Southern Great Plains Watershed Research Center.

M. H. Frere, D. A. Woolhiser, J. H. Caro, B. A. Stewart, and W. H. Wischmeier.

Journal of Soil and Water Conservation, Vol 32, No 6, November-December 1977, p 260-264. 6 fig, 1 tab, 13 ref.

Descriptors: *Water pollution control, *Erosion, *Fertilizers, *Pesticides, *Farm management, Federal water pollution control act, Agricultural chemicals, Watersheds, River basins, Runoff, Farm wastes, Nutrients, Pollution taxes, Education, Conservation, Alternative practices, *Nonpoint source pollution, Incentives.

Federal and State laws require that methods be developed for evaluating nonpoint pollution problems and for recommending control practices. Since the major responsibility for control lies with organizations covering large areas, such as river basins or states, the task is difficult at best. Control methods can be classified into two groups: (1) methods applicable to large areas, and (2) farming practices that are site-specific because of climate, topography, economics, etc. Some advantages and disadvantages of education, incentives, taxation, and legal penalties for broad areas are discussed. The use of flow charts for erosion, nutrient, and pesticide problems are briefly discussed. The charts should be useful in selecting farming practices that reduce nonpoint pollution and in evaluating their consequences. W78-04200

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION, VOLUME III. A PRELIMINARY ANALYSIS OF DAY USE RECREATION AND BENEFIT ESTIMATION MODELS FOR SELECTED RESERVOIRS, Army Engineer District, Sacramento, CA. For primary bibliographic entry see Field 4C. W78-03893

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION, VOLUME V, A GENERALIZED RECREATION DAY USE PLANNING MODEL, Army Engineer District, Sacramento, CA. For primary bibliographic entry see Field 6B. W78-03895

AN APPLICATION OF THE INTERREGIONAL I/O MODEL FOR THE STUDY OF THE IMPACT OF THE MCCLELLAN-KERR ARKANSAS RIVER MULTIPLE PURPOSE PROJECT, Catholic Univ. of America, Washington, DC. Inst. of Social and Behavioral Research. For primary bibliographic entry see Field 4A. W78-03899

CLASSIFICATION OF AMERICAN CITIES FOR CASE STUDY ANALYSIS: VOLUME I. SUMMARY REPORT, Urban Systems Research and Engineering, Inc., Cambridge, MA.

F. Lake, C. Blair, J. Hudson, and R. Tabors. Available from the National Technical Information Service, Springfield, VA 22161 as PB-271 021. Price codes: A03 in paper copy, A01 in microfiche. Report EPA-600/5-77-008a, May 1977. Socioeconomic Environmental Studies Series, 38 p, 10 tab, 2 fig, append. 68-01-3299.

Descriptors: *Methodology, *Cities, *Regional analysis, *Urban areas, *Urban sociology, *Programs, Systems analysis, Regions, Environmental effects, *Factor analysis, *Clustering, *Model cities, *City classification, Case studies, Impact analysis, Program analysis, Policy analysis.

Attempts to analyze and evaluate the impacts of federal programs have led to the extensive use of case studies of program impacts at selected sites. This study develops a methodology for the systematic selection of representative case study sites and for generalizing the study results. The methodology involves two-stage factor analysis and clustering. It is applied to the specific program/policy problem of selecting appropriate metropolitan areas for case studies when analyzing the impact of federal policies on general environmental quality. The methodology utilizes a Standard Metropolitan Statistical Area (SMSA) data base (which includes 262 SMSA's), including variables related to urban form, environmental quality, and household, industrial, and government activity. These variables are analyzed through a two-stage factor analysis technique which allows a heuristic consideration of the significant characteristics. Finally, city clusters are developed which consist of areas with similar attributes. Modal, or representative, cities are selected for each cluster of cities and are suggested as case study sites. The city clusters may be used to generalize the study results and to analyze the transferability of results between city cluster. The methodology is sufficiently flexible to consider a wide range of research hypotheses. (Nessa-NC) W78-03918

MODELS FOR ASSESSING THE ECONOMIC VALUE OF HYDROPOWER FOR PEAKING PURPOSES AND THE PRICING OF PEAKING ALTERNATIVES, Washington State Water Research Center, Pullman. For primary bibliographic entry see Field 6D. W78-03964

URBAN FLOOD WATER MANAGEMENT SYSTEMS IN SEMIARID REGIONS: MODEL EXTENSION, DESIGN AND APPLICATION, Arizona Water Resources Research Center, Tucson. K. Arai, S. Ince, and S. Resnick.

Field 6—WATER RESOURCES PLANNING

Group 6A—Techniques Of Planning

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 485, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, 1977, 63 p, 12 fig, 5 tab, 20 ref, 3 append. OWRT A-049-ARIZ(1), 14-31-0001-4003.

Descriptors: *Model studies, *Arizona, *Urban runoff, *Computer programs, *Rainfall-runoff relationships, *Thunderstorms, Reservoirs, *Storm hydrographs, Urban drainage, *Watershed management, Infiltration, Semi-arid lands, Rainfall-runoff models, Thunderstorm non-linear reservoir models, *Urban watersheds, Tucson (Ariz).

A non-linear reservoir model is used to represent the rainfall-runoff relationships for thunderstorms on the urban watersheds of Tucson, Arizona. Two types of computer programs are developed: a calibration program to obtain a best-fit calculated hydrograph; and a verification program to generate storm hydrographs given the watershed characteristics and a hyetograph. Calibration reveals the relationship of the model parameters, namely, (f) the inflow coefficient, (a) the constant coefficient, and (TL) the time lag, to the total rainfall, drainage area, channel length, and infiltration capacity of the watershed. The average discrepancy between the predicted hydrograph and the actual hydrograph for Tucson urban watersheds is 20-25 percent. W78-03965

A COMPUTERIZED METHOD FOR ABSTRACTING AND EVALUATING ENVIRONMENTAL IMPACT STATEMENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 6G.
W78-03970

WATER RESOURCES MANAGEMENT AND PLANNING: OPTIMIZATION MODELING OF MULTIPLE RESERVOIR SYSTEMS,
Washington State Univ., Pullman, Dept. of Civil and Environmental Engineering.
M. H. Houck, and B. R. Cleland.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 821, Price codes: A04 in paper copy, A01 in microfiche. Charles W. Harris Hydraulic Laboratory, Technical Report No. 54, October 1977, 69 p, 21 tab, 35 ref, append. OWRT A-086-WASH(1), 14-34-0001-7102.

Descriptors: *Multiple-purpose reservoirs, *Washington, *Model studies, *River basin planning, *Water resources management, Systems engineering, *Mathematical programming, *Optimization, Stochastic hydrology, Multiple objective programming, Decision making, Yakima River (Wash), Planning.

The class of optimization models which can be used as tools by the water resource planner or manager is examined. Five models are described and discussed in terms of their mathematical structure, computational burden or cost of solution, method of incorporating the stochastic nature of streamflow, ability to identify general optimal operating policies, and ability to identify optimal reservoir system designs. The five models are called: Multi-Year Deterministic Dynamic Program, Explicitly Stochastic Linear Program, Explicitly Stochastic Dynamic Program, and Chance Constrained Stochastic Linear Program. The Explicitly Stochastic Dynamic Program and The Chance Constrained Stochastic Linear Program are superior to the other models in terms of general usefulness. The Chance Constrained Stochastic Linear Program is the best of the models in most planning situations. W78-04106

ANALYSIS OF INFORMATION SYSTEMS FOR HYDROPOWER OPERATIONS, - EXECUTIVE SUMMARY,
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 8C.
W78-04107

THE ECONOMIC IMPACT OF COMMERCIAL SPORTS FISHING ACTIVITIES IN MOREHEAD CITY, NORTH CAROLINA.
For primary bibliographic entry see Field 6B.
W78-04145

6B. Evaluation Process

IMPACT OF GROUNDWATER DEVELOPMENT IN ARID LANDS: A LITERATURE REVIEW AND ANNOTATED BIBLIOGRAPHY,
Arizona Univ., Tucson. Office of Arid Lands Studies.

For primary bibliographic entry see Field 4B.
W78-03757

LAKES AND PONDS,
Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture.
J. Tourbier, and R. Westmacott.
Technical Bulletin 72, The Urban Land Institute, Washington, D.C., 1976, 73 p, 55 fig.

Descriptors: *Lakes, *Ponds, *Recreation facilities, *Water management (Applied), *Water resources development, *Artificial lakes, *Planning, Eutrophication, Recreation demand, Fishing, Wildlife habitats, Social aspects, Water quality control, Water pollution control, Algal control, Dam design, Land development, Landscaping.

Various aspects of planning, developing and managing natural and artificial lakes are discussed. Included are: (1) demand for, and development of, lakeshore property; (2) problems associated with lake management (site, water level maintenance, thermal stratification, siltation, water quality, eutrophication, safety, mosquitoes, wave action, and debris); (3) lake uses (aesthetic value, recreation, wildlife habitats, water storage, biological water quality improvement, storage of treated sewage effluents, detention and retention basins, and sediment control); (4) design criteria (engineering surveys, catchments, depth, dams, spillways, tricke tubes, sealing, wave action, excavated lakes and ponds, and vegetation); and (5) legal and management considerations. Water is the key element in recreational decision-making; 41% of people in the U.S. prefer water-related recreation to any other type. Purchasers of lakeshore property tend to be well-educated and have relatively high incomes, and are likely to be active in community and lake management. Profit is not generally an important reason in buying lakeshore real estate. Even in states with abundant natural lakes, developers must construct artificial lakes to meet demand. In consequence, the supply of suitable sites is becoming exhausted, and there is increasing resistance on the part of the public to damming high quality streams. This bulletin discusses the mechanics of building and maintaining artificial lakes in detail. (Lynch-Wisconsin) W78-03895

1977 REVIEW, 1978 PREVIEW.
For primary bibliographic entry see Field 4B.
W78-03848

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME I. EVALUATION OF RECREATION USE SURVEY PROCEDURES,
Army Engineer District, Sacramento, CA.
R. E. Brown, D. A. Crane, and A. M. Kinsky.

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-000 648, Price codes: A04 in paper copy, A01 in microfiche. Prepared for Institute for Water Resources (Army), Washington, D.C., October 1969, 51 p, 2 tab, 8 fig, 3 append.

Descriptors: *Recreation, *Recreation demand, *Reservoirs, *Surveys, *Methodology, *Statistical methods, Probability, Economics, Recreation facilities, Model studies, Estimating, Analytical techniques, Approximation method, Projections.

An experimental recreation-use survey was put into effect in seven Army Engineer Districts at 52 reservoir projects in 1966 to test a survey procedure designed to provide a low cost system for obtaining reliable, consistent recreation-use estimates for research and planning activities. One objective of the experimental survey was to provide the basis for designing a Corps-wide survey procedure. Testing in the seven selected districts was made so that weaknesses in the survey system could be identified and evaluated. This report presents the evaluation of the existing survey procedures and provides alternative suggestions for the improvement of the survey. The alternative survey designs presented build upon the accomplishments of the existing survey procedure. The principal improvement consists of providing relevant known probabilities so that precision of the survey information can be estimated with greater accuracy. A modified recreation use survey designed for administration by district offices is presented. The modified survey design provides for precision in estimating the accuracy of the survey information without reducing the existing survey's advantages. Alternatives to the district survey design, which could be administered from a single central Corps element, are given with explanation of the effect of the alternatives on the survey results. This report is one of five volumes in this series of studies. (See also W78-03892 thru W78-03895) (Nessa-NC) W78-03891

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME II. ESTIMATING INITIAL RESERVOIR RECREATION USE,

Army Engineer District, Sacramento, CA.
R. E. Brown, D. M. Crane, C. R. DesJardins, and R. Hydra.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-000 649, Price codes: A15 in paper copy, A01 in microfiche. Prepared for Institute for Water Resources (Army), Washington, D.C., June 1974, 359 p, 3 append.

Descriptors: *Recreation, *Recreation demand, *Reservoirs, *Estimating, *Methodology, Recreation facilities, Analytical techniques, Forecasting, Probability, Approximation method, Most similar project.

This report presents a methodology for estimating initial recreation use at prospective Corps of Engineers reservoirs. It is the outgrowth of recreation use studies instituted by the Office of the Chief of Engineers. The procedure utilizes the 'most similar project' concept. Data from an existing reservoir that is most comparable in size, operation, and anticipated recreation-use characteristics is applied to a reservoir under study to provide a basis for the use estimating technique. The report provides general descriptions, pertinent project information, and recreation use data for 52 existing Corps reservoirs. It includes detailed discussion and evaluation of a prospective reservoir project and general criteria for selecting a similar project from among the 52 existing reservoirs. An example detailing the application of the methodology is furnished. While the methodology eliminates much of the uncertainty previously associated with estimating recreation use and benefits for

WATER RESOURCES PLANNING—Field 6
Evaluation Process—Group 6B

Corps reservoir projects, it is by no means the final solution. There are inherent deficiencies in the method. However, as more recreation-use data are collected and analyzed, it is planned that the technique will be revised and improved. This report is one of five volumes in this series of studies. (See also W78-03891) (Nessa-NC)
W78-03892

PLAN FORMULATION AND EVALUATION STUDIES-RECREATION. VOLUME IV, ESTIMATING RECREATIONAL FACILITY REQUIREMENTS,

Army Engineer District, Sacramento, CA.

R. E. Brown, and G. Miller.

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-000651, Price codes: A03 in paper copy, A01 in microfiche. Prepared for Institute for Water Resources (Army), Washington, D.C. June 1974, 24 p, 2 tab, 7 ref, append.

Descriptors: *Methodology, *Recreation, *Recreation facilities, Economics, Cost-benefit analysis, Model studies, Estimating, Analytical techniques, Approximation method, Estimating equations, Projections, Statistical methods, Most similar project(Recreation).

The study's purpose is to present a general methodology for estimating the number and type of recreational facilities identified with a particular activity needed to serve a number of recreation days at a proposed reservoir. The planning procedure synthesizes planner judgment, existing recreational use survey data, and the concepts of estimating annual recreational use employed by the Corps of Engineers. The data were collected at 52 reservoirs in the period from 1966 through 1969. The facility requirements planning methodology developed assumes that the size of the proposed reservoir site has been determined and that annual total recreational use estimates have been computed. The implication of this assumption is that the planning process under consideration is a process of accommodating recreational use. Alternative investment levels can be used to inhibit or induce recreational use levels, but the purpose of the facility planning process is to respond to expected use levels, not to affect them. The planning process can effectively employ annual use estimates derived in different ways, but familiarity with the concept of estimating from data on the 'most similar project' is required. This concept is detailed in Volume II of this study. There are 5 volumes in this series of studies. (See also W78-03891) (Nessa-NC)
W78-03894

PLAN FORMULATION AND EVALUATION STUDIES-RECREATION. VOLUME V, A GENERALIZED RECREATION DAY USE PLANNING MODEL,

Army Engineer District, Sacramento, CA.

R. E. Brown, and W. J. Hansen.

Available from the National Technical Information Service, Springfield, VA 22161 as ADA-000652, Price codes: A03 in paper copy, A01 in microfiche. Prepared for Institute for Water Resources (Army), Washington, D.C. June 1974, 37 p, 5 tab, 3 fig, 22 ref.

Descriptors: *Recreation, *Recreation demand, *Reservoirs, *Model studies, *Methodology, *Recreation facilities, Economics, Cost-benefit analysis, Estimating, Analytical techniques, Approximation method, Estimating equations, Projections, Statistical methods, *Travel-costs, *Travel-cost model, *Army Engineer District-Sacramento, Fort Worth, Little Rock, Tulsa.

This study offers refined procedural guidelines for an analytical evaluation of reservoir recreation use and benefits consistent with the requirements of the Federal Water Projects Recreation Act of 1965

and with the Water Resources Council's (WRC) 'Proposed Principles and Standards for Planning Water and Related Land Resources.' A general model is described for use in project planning. Two empirical demonstrations are given with sensitivity analyses of the evaluations. An outline is presented of the general steps involved in replicating the procedure. The most widely used existing methods for estimating recreation benefits are imprecise. A travel-cost method is suggested as a theoretical and empirical improvement. The general planning model that is described and tested consists of the development of regional estimators for predicting recreation use at proposed reservoir projects and the operation of these estimators to derive the individual project demand schedules for estimating recreation benefits. Although the same variables significantly affected recreation in different geographic regions, the magnitude of the effects varied between regions. Using data collected from 31 reservoirs, homogeneous regions were identified for which sufficiently accurate use estimators could be developed. This study is a refinement of work presented in the four preceding volumes of this series. (See also W78-03891) (Nessa-NC)
W78-03895

GUIDELINES FOR ATTRACTING PRIVATE CAPITAL TO CORPS OF ENGINEERS PROJECTS,

West Virginia Univ., Morgantown. Bureau of Business Research.

For primary bibliographic entry see Field 6C.

W78-03896

ROCKY MOUNTAIN ENVIRONMENTAL RESEARCH QUEST FOR A FUTURE: PROBLEMS AND RESEARCH PRIORITIES IN THE ROCKY MOUNTAIN REGION.

Eisenhower Consortium for Western Environmental Forestry Research, Fort Collins, CO. Available from the National Technical Information Service, Springfield, VA 22161 as PB-256 446, Price codes: A13 in paper copy, A01 in microfiche. Prepared for National Science Foundation, Washington, D.C., Research Applied to National Needs, 1975, 286 p, 2 append. NSF-GI-39421.

Descriptors: *Environmental effects, *Assessments, *Management, *Rocky Mountain Region, *Growth rates, *Planning, *Research priorities, Forecasting, Mining, Technology, Land development, Recreation, Rural areas, Economic impact, Mathematical models, Water resources, Sewage treatment, Watersheds, Irrigation, River basins, Flood control, Desalination, Cloud seeding, Institutions, Land use, *Human ecology, *Ecosystems, Energy resources, Mineral resources, Population growth.

This study identifies environmental problems and research questions in the Rocky Mountain Region. The research will be used to make management decisions to preserve and enhance the Region for future generations. The purpose of the research was to identify and evaluate current and potential problems associated with the growing interaction of people and natural environments in the Region, and to determine and establish priorities for the research required to provide the necessary basis for environmentally sound resource management on public and private land. Task forces were formed to address several subject areas, including biological resources; human needs and responses; institutional arrangements; mineral and energy resources; recreation and tourism; rural residential development; timber and forage uses; and water resources and uses. An interdisciplinary and broad based committee was selected by task force leaders to determine the state of knowledge in each field, the gaps in knowledge, and thus the major needs to be researched. The findings of each task force were documented and a draft of each task force report was sent for review. The review comments were incorporated in the final reports presented here. (Nessa-NC)

W78-03897

AN ECONOMIC OVERVIEW OF HAWAII'S WATER INSTITUTIONS,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 6E.
W78-03930

WATER SHORTAGE IN ISRAEL: LONG-RUN POLICY FOR THE FARM SECTOR,
New Mexico Univ., Albuquerque. Dept. of Economics.
For primary bibliographic entry see Field 3F.
W78-03990

PRINCIPLES FOR WATER QUALITY MANAGEMENT,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5G.
W78-03993

OPTIMUM SIZE LIMIT FOR A FISHERY WITH A LIMITED FISHING SEASON,
Western Australia Univ., Nedlands. Dept. of Mathematics.

B. S. Goh.
Ecological Modelling, Vol 3, No 1, p 3-15, 1977. 1 fig, 9 ref, append.

Descriptors: *Fisherries, *Fishing, *Optimization, *Size limit, Management, Seasonal, Constraints, Time-invariant linear model, Total biomass yield, Maximization, Control theory, Harvesting, Methodology, Algorithms, Computation, Mathematical models, Equations, Systems analysis.

In the management of a fishery with many year-classes, a standard objective is to maximize the biomass yield. If the fishing effort is fixed, this objective can be attained by prescribing an optimum size limit. This implies that only fish which are larger than the optimum size limit should be caught. The theory for computing the optimum size limit when fishing is carried out continuously is well established. In contrast, the theory for computing the optimum size limit when the fishing season is limited to the same period in each year has not been developed, in spite of the fact that many fisheries are being exploited. A fishing season may be limited because the weather or the migration patterns of the fish population permit fishing only during a certain period in the year. A season may also be limited because it is necessary to reduce the fishing mortality in order to conserve the fish population. A theory for computing the optimum size limit when the fishing season is limited is developed herein and is applied to a hypothetical fishery. The data for this example comes from the North Sea plaice fishery. It is found that for a given fishing effort, the optimum size limit is 44.5 cm if fishing is carried out continuously, 41.3 cm if fishing is limited to 6 months per year, and 28.7 cm if fishing is limited to a period of a tenth of a year per year. (Bell-Cornell) W78-03995

COMMERCIAL AND INSTITUTIONAL WATER USE IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. School of Engineering.

A. G. Valentin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 804, Price codes: A04 in paper copy, A01 in microfiche. Puerto Rico Water Resources Research Institute Mayaguez, Completion Report, September 1976, 46 p, 15 fig, 8 tab, 16 ref. OWRT A-045-PR(1).

Descriptors: *Water utilization, *Industrial water, *Domestic water, *Distribution systems, Water demand, Peak ratios, *Puerto Rico, Cities, Commercial water use, Institutional water use.

Field 6—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

Objectives were to investigate the commercial and institutional water-use situation in the Island of Puerto Rico and estimate the expected and design water-use indices for various types of establishments. The sample included hotels, department stores, car washes, automobile service stations, laundries, restaurants, barber shops, primary and secondary schools, colleges and universities, hospitals and churches. Analyses reveal that: (1) more than half of the sample of establishments lack the availability of lawn or garden areas; (2) the public aqueduct is almost the sole water intake source, with almost no additional treatment prior to use; (3) only about 16% of the sample reported using evaporative air conditioning; (4) there is a lack of knowledge on water-usage ratios among establishments; (5) almost no water recirculation is practiced; (6) personal use, general cleaning and service-spending water uses, ranked highest; (7) almost all water discharges reported as going into the public sewer system; (8) the most common water uses were food processing, steam producing, laundering, dishwashing, shampooing, air conditioning, icemaking and solvent cooling. The minimum, average and maximum service capacities were calculated and water-use 'expected' and 'design' indices were estimated.

W78-04097

WATER RESOURCES MANAGEMENT AND PLANNING: OPTIMIZATION MODELING OF MULTIPLE RESERVOIR SYSTEMS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6A.
W78-04106

THE ECONOMIC IMPACT OF COMMERCIAL SPORTS FISHING ACTIVITIES IN MOREHEAD CITY, NORTH CAROLINA.
Prepared by Coastal Resources Corporation for N.C. Department of Administration, (Raleigh), April 1, 1972, 3 fig, 30 tab, 6 append.

Descriptors: *Commercial fishing, *Sports fishing, *Methodology, *Input-output analysis, *Economic impact, *North Carolina, Economics, Mathematical studies, Recreation, Tourism, Income, Morehead City(NC), Carterette County(NC).

This study reports an estimate of the economic gains realized in a single county from a portion of the total sports fishing activity that takes place in that county; specifically, the commercial facilities that cater to sports fishermen in Morehead City, Carterette County, North Carolina, under conditions and policies prevailing in 1971. The study addresses the problems of economic impact, planning systems, and marketing strategy. The research methodology consisted of: designing the method for evaluation of recreation-tourism enterprises; testing, refining, and finalizing the design, including survey questionnaires; a survey of fishermen that varied by type of facility and season; a direct mail questionnaire to lessees of wet and dry boat storage space in Morehead City marinas; interviews of operators of primary and secondary sports fishing enterprises to acquire information on the history and character of the enterprise, gross income, and the distribution of annual expenditures to salaries, and operating expenses according to the location of the recipient. This information was used to construct matrices describing the sports fishing sector of the economy. The final analytical step consisted of checking data available from the Bureau of the Census and the Office of Business Economics; the tabulation and analysis of the data; and the calculation of the economic impact of the several types of commercial sports fishing opportunities available by season. (Nessa-NC)
W78-04145

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY—A STRATEGY FOR BALANCED DEVELOPMENT AND PROTECTION OF WATER AND RELATED LAND RESOURCES IN EASTERN MASSACHUSETTS AND RHODE ISLAND.

New England River Basins Commission, Boston, MA.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-252 166, Price codes: A04 in paper copy, A01 in microfiche. Regional Report December 1975, 3 maps, 3 append. Summary, December 1975, 48 p.

Descriptors: *Natural resources, *Land resources, *Water resources, *Conservation, *Regional development, Water resources development, Water supply, Water conservation, Economics, Administration, Management, Planning, Water quality, Outdoor recreation, Sites, Locations, Flood control, Flood damage, Erosion, *Massachusetts, Land development, *Rhode Island, Marine management.

The Southeastern New England (SENE) study's goals were twofold: to identify and recommend public and private actions to be taken to provide for balanced conservation and development of the region's water and land resources; and to develop a water and land resource data base. The study's conclusion that both growth accommodation and the provision of economic opportunities are compatible with the protection of the region's natural resources was based on three findings: enhancing the environment enhances the region's economy; anticipated growth can be accommodated and should be guided to protect fragile resources and make development more efficient; and existing knowledge, programs and institutions provide the tools for achieving results, but some changes are needed. Planning objectives and recommendations for several natural resource priorities—guiding growth, water supply, water quality, outdoor recreation, marine management, flooding and erosion and site location of key facilities—were presented. The study concludes with several options for integrating water and land resources policy making and program management into other economic and social programs of the region. (Zayac-NC)
W78-04146

TRIAL APPLICATION OF REVISED EVALUATION PROCEDURES AT KINGSPORT, TENNESSEE.

Tennessee Valley Authority, Kingsport. Available from the National Technical Information Service, Springfield, VA 22161 as PB-255 840, Price codes: A06 in paper copy, A01 in microfiche. A Report to the Water Resources Council's Special Task Force on Evaluation Procedures, March 1970, 43 p, 3 tab, 6 plates, 3 append.

Descriptors: *Evaluation, Analytical techniques, *Cost-benefit analysis, *Planning, Cost analysis, Theoretical analysis, Comparative costs, Land use, Water resources, Measurement, Environmental effects, Interest rates, Multiple purpose, Recreation, Employment, Project benefits, Tennessee, Flood plains, Flood damage, *Sensitivity analysis, *Multiple objective planning, Reedy Creek(TN), Kingsport(TN).

This study describes a trial application of the revised evaluation procedures for water and related land resources projects presented in the June, 1969 report of the Water Resources Council's Special Task Force on Evaluation Procedures. The trial application was confined to the evaluation of alternatives under consideration by TVA in its current planning at Kingsport, Tennessee. The evaluation was confined to a comparison of five alternative means of flood damage reduction. Each alternative included a single land use plan selected to satisfy various portions of Kingsport's projected land needs. Measurement of effects was concentrated on those that could be in-

cluded in income accounts. New procedures were used to evaluate, in monetary terms, enhanced employment, land enhancement along reservoir shorelines, and estimates of the value of recreation at neighborhood parks and play areas. Acceptable but not final procedures were developed. Non-monetary benefits measured were in the environmental account and included acres of greenbelt and miles of natural stream. Conclusions were not found sensitive to a variation in interest rates between 3.25 and 6 percent, and project life between 50 and 100 years. The multi-objective planning approach was found good in principle but in need of refinement. (Nessa-NC)
W78-04148

MOTORS AND OARS IN THE GRAND CANYON. RIVER CONTACT STUDY, PART II, Human Ecology Research Services, Inc. Boulder, CO.

B. Shelby, and J. M. Nielsen.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 730, Price codes: A04 in paper copy, A01 in microfiche. Final Report, June 1976. 59 p, 11 tab, 26 ref, 2 append. CX821040104.

Descriptors: *Boating, *Recreation demand, *Colorado River, *Social aspects, *Grand Canyon(AZ), Arizona, Rivers, Resource allocation, Environmental effects, Recreation facilities, Surveys, Planning, Wilderness areas.

A policy conflict over use of motorized boats in the Grand Canyon, especially by commercial outfitters using large pontoon rafts in what was previously a nonmechanized wilderness area, is assessed by means of surveys of both motor and oar passengers. Passengers on combination trips exposed to both motor and oar travel preferred oar travel (79.91%) over motor travel (4.6%). Reasons given included the slower, more relaxed pace; quiet; trip environment more sensitive to the river and Canyon; and smaller, more comfortable social groupings. No difference was perceived in terms of safety. Motor trips tend to involve more total passengers and more people per boat, have more contact with other parties each day, spend less time in the canyon, make fewer and shorter side trips, and make more adjustments for crowding. The motor-oar combination trips were especially designed for this study for evaluation purposes, and provided data on perceptions and preferences. Standard trips, in which boaters tended to have experienced only one of the two types of travel, provided comparative information on length of trips, size of party, and social, economic, and demographic characteristics. Motor and oar boaters in this latter group were similar in background, but commercial trip passengers had higher average incomes and educational levels and lived in or around big cities. Effects of an oars-only policy in the canyon is evaluated. (Lynch-Wisconsin)
W78-04151

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

GUIDELINES FOR ATTRACTING PRIVATE CAPITAL TO CORPS OF ENGINEERS PROJECTS,

West Virginia Univ., Morgantown. Bureau of Business Research.

G. R. Dreese, T. S. Witt, and J. M. Rovelstad. Available from the National Technical Information Service, Springfield, VA 22161 as ADA-041 571, Price codes: A11 in paper copy, A01 in microfiche. Prepared for Army Engineer Institute for Water Resources, Fort Belvoir, VA. Vols I and II, March 1977, 208 p. DACW31-75-c-0077.

Descriptors: *Recreation facilities, *Investment, *Profit, *Forecasting, *Feasibility studies, Capital, Capital supply, Management, Pricing, Regulation, Regression analysis, Mathematical

WATER RESOURCES PLANNING—Field 6

Water Demand—Group 6D

studies, Statistical methods, Statistical data, *Small businesses, Concessionaires, *Ragstown Lake(PA), Standardized accounting audits, Discriminant analysis.

The study is presented in 2 volumes—Vol. I is devoted to the development and estimation of a statistical model of Corps concessionaires; Vol. II is a feasibility study for the newly-developed Ragstown Lake project in Pennsylvania, using the model developed in Vol. I. Vol. I analyzes Corps of Engineers commercial concessionaires located on Corps projects throughout the U.S. The objective was to isolate the policy and procedural means by which additional private capital could be attracted to meet the needs of nearly 400 million visitors who use recreation facilities at Corps projects. Corps concessionaires are small businesses and suffer the problems of all small businesses. No single factor was found to influence profitability. The report's conclusions dispute many of the commonly held assumptions about factors critical to profitability. The recommendations are directed at Corps managers. Standardization of accounting procedures and periodic audits to maintain quality control of financial information provided by concessionaires are clearly indicated. Developing training and other management improvement programs for concessionaire operators appears warranted. The Small Business Administration could provide this service. If additional capital inflows from private sources are to be encouraged, controls and other inhibitions on pricing of concessionary services and competitive services supplied by the Corps should be relaxed. Corps sponsored market studies for individual concessionaire sites offer limited assistance in finding and assuring profitable concessionaire operators. Vol. II is a feasibility study; it forecasts demand for basic marina services at Ragstown Lake, PA, and provides estimates of capital cost structure and operating profits/losses for various blends of business activity. (Nessa-NC) W78-03896

WATER SHORTAGE IN ISRAEL: LONG-RUN POLICY FOR THE FARM SECTOR,
New Mexico Univ., Albuquerque. Dept. of Economics.

For primary bibliographic entry see Field 3F.

W78-03990

A PROFILE OF THE COMMERCIAL FISHINGMEN IN COASTAL LOUISIANA,
Louisiana Wildlife and Fisheries Commission, New Orleans. Seafood Div.

P. Bowman, G. Adkins, and J. Tarver.

Technical Bulletin No 25, September 1977, 9 p. 2 fig, 6 tab, 4 ref.

Descriptors: Management, *Fish management, *Commercial fishing, *Louisiana, Coasts, Fish, Fishing, Trout, Drums, Finfishermen, *Spotted seatrout, *Red drum.

696 commercial fishermen were interviewed during May, 1976. Results of these interviews indicated that professional fishermen made up 9.4% of those interviewed, possessed 34.6% (92 205 feet) of the nets, and averaged 1,579.8 feet of net/fisherman. Casual fishermen made up 90.6% of the fishermen interviewed, owned 65.4% of the nets, and averaged 309.5 feet of net/fisherman. Professional fishermen fished an average of 166.8 days each in 1975 and landed 3,570,295 pounds of fish. During the same period, each casual fisherman fished an average of 15.7 days, catching 1,831,345 pounds of fish. No information was available on the number of recreational fishermen and the amount of fish they caught. The purpose for the gathering of this information was the development of a management plan for spotted seatrout and red drum. (Chilton-ORNL) W78-04118

OYSTER DISTRIBUTION AND DENSITY ON THE PRODUCTIVE PORTION OF STATE SEED GROUNDS IN SOUTHEASTERN LOUISIANA,
Louisiana Wildlife and Fisheries Commission, New Orleans. Seafood Div.

R. J. Dugas.
Technical Bulletin No 23, September 1977, 27 p. 9 fig, 4 tab, 21 ref.

Descriptors: *Environmental effects, Management, *Fish management, Shellfish, Oysters, *Louisiana, Salinity, Hatcheries, Seed grounds.

An investigation was made to determine oyster reef distribution, oyster density on these reefs, environmental conditions influencing this density and distribution, and fishing pressure so that management decisions on this living renewable resource might be made. There is an optimum salinity regime within which oysters survive, grow and reproduce. An inward shift of this optimum salinity zone is occurring due to the reduction of freshwater flow entering the estuaries either from low rainfall or low river discharges. Several recommendations are suggested: (1) legally describe and define the Oyster Seed Ground area and adopt this description as policy in the event a quick alteration line is required; investigate the feasibility of obtaining some means of returning the discarded oyster shells from shucking and canning operations to the grounds; develop the technology for oyster hatchery program as a supply of seed oysters to be deposited on the grounds; and continue to monitor all the Oyster Seed Grounds. (Chilton-ORNL) W78-04119

6D. Water Demand

SOURCES OF EMERGENCY WATER SUPPLIES IN SANTA CLARA COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.

J. P. Akers.

Water-Resources Investigations 77-51 (open-file report), August 1977. 21 p, 2 fig, 2 tab, 22 ref.

Descriptors: *Water supply, *Alternate planning, *Disasters, *California, *Water wells, Water distribution(Applied), Civil defense, Public health, Water purification, Methodology, *Emergency water supplies, *Santa Clara County(Calif).

Water distribution systems in Santa Clara County, Calif., may be damaged and rendered inoperable by a large earthquake or other disaster. In such an event, individual agencies may have to implement emergency measures to supply water for drinking, firefighting, decontamination, or other purposes. In Santa Clara County, 128 wells have been identified as potential water-supply sources in emergencies. The criteria used to select the wells are: yield of at least 3 liters per second (50 gallons per minute), good water quality, ready accessibility, and available emergency power. Purification methods of small water supplies are described. (Woodard-USGS) W78-03772

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME I. EVALUATION OF RECREATION USE SURVEY PROCEDURES,
Army Engineer District, Sacramento, CA.

For primary bibliographic entry see Field 6B.
W78-03891

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME II. ESTIMATING INITIAL RESERVOIR RECREATION USE,
Army Engineer District, Sacramento, CA.

For primary bibliographic entry see Field 6B.
W78-03892

PLAN FORMULATION AND EVALUATION STUDIES—RECREATION. VOLUME IV. ESTIMATING RECREATIONAL FACILITY REQUIREMENTS,
Army Engineer District, Sacramento, CA.

For primary bibliographic entry see Field 6B.
W78-03894

MODELS FOR ASSESSING THE ECONOMIC VALUE OF HYDROPOWER FOR PEAKING PURPOSES AND THE PRICING OF PEAKING ALTERNATIVES,
Washington State Water Research Center, Pullman.

R. J. Hanson, and C. B. Millham.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 633. Price codes: A09 in paper copy, A01 in microfiche. Completion Report (Parts I-III), August 15, 1976. 162 p. OWRT B-057-WASH(1). 14-31-0001-5124.

Descriptors: *Hydroelectric power, *Storage reservoirs, *Computer programs, Model studies, Costs, *Simulation analysis, *Peak power, Peak-ing capacity, Algorithms, *Snake-Columbia hydroelectric system.

A computer data structure and computer program are described for the fast evaluation and computation of power for 47 generation projects, and release evaluation for 4 storage reservoirs on the Snake and Columbia Rivers and tributaries. The system and its parameters are defined, complications in power computation are described, and the method of the cubic spline representation with its associated data structure is described. Graphs of the cubic-spline fits and tables of the spline coefficients are provided. An algorithm is presented for operating the Snake-Columbia hydroelectric system through the critical historical flow years. This operation allows the user to input constraints of monthly elevation or storage, minimum or maximum stream flows, and interregional transfers of water. By comparing a base operation with a new scenario (such as a large irrigation project) a public cost of lost base hydropower load can be obtained. The costs of replacement can then be computed and a reasonable estimate of the public's cost can be presented. A computer program has been written to carry out these computations. The program works within the required constraints to meet a monthly load or power requirements. The incremental storage changes are chosen to be released from the various control reservoirs on the basis of optimal power gain-to-loss ratios. The application of the simulation model developed is discussed. The case studies include diversion (interregional transfer), minimal instream flows, minimum reservoir elevation constraints, and mixtures of these stipulations. The development of the loads is described also. While these case studies were done using the simulation model, they could also have been done using the PASO operating model developed as part of this project. W78-03964

COMMERCIAL AND INSTITUTIONAL WATER USE IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. School of Engineering.

For primary bibliographic entry see Field 6B.
W78-04097

IDAHO WATER SUPPLY PROGRAM.
Environmental Protection Agency, Seattle, WA. Air and Water Programs Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-243 669

and PB-243 670. Price codes: A03 in paper copy,

A01 in microfiche. Evaluation, October 1973. 207 p, 5 fig, 8 tab, 6 ref, 5 append; Summary, October 1973, 32 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Water supply, *Administration, *Regulation, *Management, *Idaho, Water supply

Field 6—WATER RESOURCES PLANNING

Group 6D—Water Demand

development, Water allocation(Policy), Water distribution(Applied), Water management(Applied), Institutional constraints, Legal aspects, Water quality, Engineering, Idaho Drinking Water Standards(1964).

The purposes of the study were fourfold: to ascertain the condition of Idaho's water supplies; to determine the adequacy of legal, policy-making, educational and technical support systems; to evaluate the effectiveness of the Idaho water supply program; and to recommend improvements and additions which may be needed to assure an adequate supply of safe drinking water for residents of Idaho. Investigations of the physical water supply system included bacteriological and chemical testing of water quality and an inventory of facilities and operation. Study of the state water supply program included a review of state authority, regulation and standards; a review of state organization, manpower and budget; and a survey of engineering activities and laboratory support. The study's recommendations included: an increase in the water supply program budget and manpower sources; an expansion of the bacteriological and chemical surveillance programs; a revision of the 1964 Idaho Drinking Water Standards; enabling legislation to require water supply operator certification, system planning and development, and fluoridation; the establishment of a program to document related policy decisions; and that computer services be used to monitor the new water supply program. (Zayac-NC) W78-04147

ENVIRONMENTAL IMPACTS OF THE GENERATION OF ELECTRICITY IN THE PACIFIC NORTHWEST. VOLUME II.

Equitable Environmental Health, Inc., Woodbury, NY.

For primary bibliographic entry see Field 6G.

W78-04149

6E. Water Law and Institutions

LEGAL AND ADMINISTRATIVE ASPECTS OF BOTTOM SEDIMENT MANAGEMENT, CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.

For primary bibliographic entry see Field 5G.

W78-03746

PROGRAM OBJECTIVES FOR THE NATIONAL WATER DATA EXCHANGE (NAWDEX) FOR FISCAL YEAR 1978, GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.

For primary bibliographic entry see Field 7C.

W78-03767

BIBLIOGRAPHY OF REPORTS BY MEMBERS OF THE U.S. GEOLOGICAL SURVEY ON THE WATER RESOURCES OF ALASKA, 1870 THROUGH 1976.

Geological Survey, Anchorage, AK. Water Resources Div.

For primary bibliographic entry see Field 10C.

W78-03778

DESIGN OF WATER RESOURCES PROJECTS WITH INADEQUATE DATA, VOLUME 2.

International Association of Scientific Hydrology, Gentbrugge (Belgium).

For primary bibliographic entry see Field 4A.

W78-03783

THE SAFE DRINKING WATER ACT: A DOLARS AND SENSE PERSPECTIVE, ECODYNE CORP., ST. PAUL, MN. LINDSAY DIV.

For primary bibliographic entry see Field 5G.

W78-03846

DRINKING WATER STANDARDS: PRINCIPLES AND HISTORY 1914 TO 1976.
Environmental Protection Agency, Boston, MA. Water Supply Branch.
For primary bibliographic entry see Field 5G.
W78-03847

WATER CONSERVATION: DRAMATIC CHANGES TAKING PLACE.
Eutek, Inc., San Francisco, CA.
For primary bibliographic entry see Field 3E.
W78-03851

MANPOWER AND TRAINING NEEDS OF STATE WATER POLLUTION CONTROL AGENCIES.
ABT Associates, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W78-03890

ENERGY DEVELOPMENT AND LAND USE IN TEXAS.
Texas Transportation Inst., College Station.
For primary bibliographic entry see Field 3E.
W78-03900

AN ECONOMIC OVERVIEW OF HAWAII'S WATER INSTITUTIONS.
Hawaii Univ., Honolulu. Water Resources Research Center.
H. Yamauchi.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 357. Price codes: A02 in paper copy, A01 in microfiche. Water Resources Bulletin, Vol. 13, No. 4, p. 759-768, August 1977. 8 ref. OWRT A-019-HI(4), 14-31-0001-3211.

Descriptors: *Institutional economics, *Water policy, *Water rights, Environmental laws, *Common property, *Hawaii, Water allocation(Policy), Legal aspects.

The problem of allocating scarce water resources among competing uses and users over time in Hawaii is addressed with the context of analytical institutional economics. The nature of this problem has been, in recent years, highly complicated by important institutional changes that control operating decisions for water supply and water pollution. Whereas the imbalance in governmental initiatives regarding changes in the system of water rights (predominantly state) and environmental laws (predominantly federal) are based on U.S. constitutional provisions, the more fundamental roots of the crucial legal doctrines involved have been traced back to the common property concept. This suggests that the more promising opportunities for meeting the water policy challenges of the state are to be found in the historical common property system (ahupua'a) of Hawaii.
W78-03930

IDAHO WATER SUPPLY PROGRAM.
Environmental Protection Agency, Seattle, WA. Air and Water Programs Div.

For primary bibliographic entry see Field 6D.

W78-04147

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION: PAMUNKEY RIVER, HANOVER COUNTY, VIRGINIA.
Army Engineer District, Norfolk, VA.
For primary bibliographic entry see Field 4A.
W78-03902

FLOOD PLAIN INFORMATION: ALLEGHENY RIVER, ARMSTRONG COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.

For primary bibliographic entry see Field 4A.
W78-03913

For primary bibliographic entry see Field 4A.
W78-03903

FLOOD PLAIN INFORMATION: ALLEGHENY RIVER, NEW KENSINGTON, ARNOLD, LOWER BURRELL AND ALLEGHENY TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03904

FLOOD PLAIN INFORMATION: OHIO, ALLEGHENY, MONONGAHELA AND YOUGHOHENY RIVER, ALLEGHENY COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03905

FLOOD PLAIN INFORMATION: CONEMAUGH AND LITTLE CONEMAUGH RIVERS, STONY AND BENS CREEKS, CITY OF JOHNSTOWN AND VICINITY, CAMBRIA AND SOMERSET COUNTIES, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03906

FLOOD PLAIN INFORMATION: PETERS CREEK, JEFFERSON BOROUGH, ALLEGHENY COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03907

FLOOD PLAIN INFORMATION: FRENCH CREEK, COCHRANTON, CRAWFORD COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03908

FLOOD PLAIN INFORMATION: CLARION RIVER AND SILVER CREEK, JOHNSONBURG, ELK COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03909

FLOOD PLAIN INFORMATION: HARE AND BEAR CREEKS, CORRY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03910

FLOOD PLAIN INFORMATION: MONONGAHELA RIVER, CALIFORNIA, COAL CENTER, AND WEST BROWNSVILLE, WASHINGTON COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03911

FLOOD PLAIN INFORMATION: BLACKSTONE RIVER, CUMBERLAND, LINCOLN, CENTRAL FALLS, AND PAWTUCKET, RHODE ISLAND.
Army Engineer District, Waltham, MA.
For primary bibliographic entry see Field 4A.
W78-03912

FLOOD PLAIN INFORMATION: WEST BRANCH SUSQUEHANNA RIVER (EAST), LYCOMING COUNTY, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 4A.
W78-03913

WATER RESOURCES PLANNING—Field 6

Ecologic Impact Of Water Development—Group 6G

FLOOD PLAIN INFORMATION: FRANKSTOWN BRANCH JUNIATA RIVER, WILLIAMSBURG, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 4A.
W78-03914

FLOOD HAZARD REPORT: SHICKSHINNY CREEK, LUZERNE COUNTY, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 4A.
W78-03915

FLOOD PLAIN INFORMATION: BIG SANDY RIVER, WAYNE COUNTY, WEST VIRGINIA.
Army Engineer District, Huntington, WV.
For primary bibliographic entry see Field 4A.
W78-03916

FLOOD HAZARD INFORMATION: BUFFALO CREEK, LOGAN COUNTY, WEST VIRGINIA—POST DISASTER CONDITIONS.
Army Engineer District, Huntington, WV.
For primary bibliographic entry see Field 4A.
W78-03917

6G. Ecologic Impact Of Water Development

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: FORMALDEHYDE.
Atlantic Research Corp., Alexandria, VA.
For primary bibliographic entry see Field 5B.
W78-03714

CHLORDANE AND HEPTACHLOR IN RELATION TO MAN AND THE ENVIRONMENT. A FURTHER PESTICIDE REVIEW 1972-1975.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
For primary bibliographic entry see Field 5B.
W78-03715

INVESTIGATION OF SELECTED POTENTIAL ENVIRONMENTAL CONTAMINANTS: ACRYLAMIDES.
Syracuse Research Corp., NY. Center for Chemical Hazard Assessment.
For primary bibliographic entry see Field 5B.
W78-03717

PESTICIDAL ASPECTS OF CHLORDANE IN RELATION TO MAN AND THE ENVIRONMENT.
Environmental Protection Agency, Washington, DC. Office of Pesticide Programs.
For primary bibliographic entry see Field 5B.
W78-03721

SETTLER'S CABIN PARK: ENVIRONMENTAL ASSESSMENT OF MINE DRAINAGE POLLUTION.
Ackenheil and Associates Geo Systems, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5G.
W78-03723

ECOLOGICAL CONSIDERATIONS IN SITE ASSESSMENT FOR DREDGING AND SPOILING ACTIVITIES.
Environmental Research Lab., Narragansett, RI.
For primary bibliographic entry see Field 5C.
W78-03751

DREDGE DISPOSAL STUDY: SAN FRANCISCO BAY AND ESTUARY. MAIN REPORT.
Army Engineer District, San Francisco.
For primary bibliographic entry see Field 5E.
W78-03875

NATURAL HAZARD MANAGEMENT IN COASTAL AREAS.
Colorado Univ., Boulder. Inst. of Behavioral Science.
For primary bibliographic entry see Field 5G.
W78-03879

MARINE STUDIES OF SAN PEDRO, CALIFORNIA. PART II. POTENTIAL EFFECTS OF DREDGING ON THE BIOTA OF OUTER LOS ANGELES HARBOR. TOXICITY, BIOASSAY AND RECOLONIZATION STUDIES.
University of Southern California, Los Angeles. Allan Hancock Foundation; and University of Southern California, Los Angeles. Inst. of Marine and Coastal Studies.
For primary bibliographic entry see Field 5C.
W78-03882

ROCKY MOUNTAIN ENVIRONMENTAL RESEARCH. QUEST FOR A FUTURE. PROBLEMS AND RESEARCH PRIORITIES IN THE ROCKY MOUNTAIN REGION.
Eisenhower Consortium for Western Environmental Forestry Research, Fort Collins, CO.
For primary bibliographic entry see Field 6B.
W78-03897

ENERGY DEVELOPMENT AND LAND USE IN TEXAS.
Texas Transportation Inst., College Station.
For primary bibliographic entry see Field 3E.
W78-03900

A COMPUTERIZED METHOD FOR ABSTRACTING AND EVALUATING ENVIRONMENTAL IMPACT STATEMENTS.
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
G. F. Martel, and R. T. Lackey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-277 459, Price codes: A05 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Blacksburg, Bulletin 105, December 1977. 93 p, 24 fig, 8 tab, 24 ref. OWTR A-070-VA(1).

Descriptors: *Reservoirs, Impoundments, *Computer programs, *Probability, Statistics, *Environmental effects, Simulation analysis, Methodology, Evaluation, *Environmental impact statements, Environmental analysis, *Environmental assessment, Dams.

This study describes the Dam Impact Evaluation System (DES), developed specifically for evaluating and comparing impacts from dam projects and project alternatives. DES operates on the creation of a distribution based on low, most likely, and high inputs by project evaluators on both impact and importance of factors and actions. Computer output includes comparisons between projects in both tabular and graphic form. Information is available on estimated impact, variance of the estimator's inputs, and probabilities of differences between projects. DES provides a method by which the value judgments and estimates of evaluators may be dealt with statistically. Both impact and weighting factors are considered, based on the probability distributions of evaluator input. Weighting factors are combined with impact to form weighted values that may be used in comparing dam projects and alternatives. In addition, DES utilizes the input for maximum information. The high, low, and most likely values for each evaluator are used to create variance and mean

values which may be used in project comparisons and/or evaluation. The estimation of variances is valuable because it indicates areas of uncertainty. Factors with large variances may need additional data information to ensure more accurate prediction. Further, the distributions and numeric output indicate areas where the dam project may cause significant change or alteration. Finally, DES creates understandable, usable output graphically and numerically.
W78-03970

DERIVATION OF RESIDUAL COEFFICIENTS FOR TYPICAL INDUSTRIES IN NEW ENGLAND.
Center for the Environment and Man, Inc., Hartford, CT.
For primary bibliographic entry see Field 5G.
W78-03988

EFFLUENT STANDARDS—EFFECT UPON DESIGN.
Los Angeles Bureau of Sanitation, CA.
For primary bibliographic entry see Field 5G.
W78-03991

AQUATIC IMPACT ASSESSMENT AT CALVERT CLIFFS.
Martin Marietta Environmental Technology Center, Baltimore, MD.
For primary bibliographic entry see Field 5C.
W78-04062

ECOLOGICAL LAND UNITS OF BEAR CREEK WATERSHED AND THEIR RELATIONSHIP TO WATER QUALITY.
Oregon State Univ., Corvallis. Water Resources Research Inst.
For primary bibliographic entry see Field 4D.
W78-04099

1977 ENVIRONMENTAL CONDITIONS RELATIVE TO SHRIMP PRODUCTION IN COASTAL LOUISIANA ALONG WITH SHRIMP CATCH DATA FOR THE GULF OF MEXICO.
Louisiana Wildlife and Fisheries Commission, New Orleans. Seafood Div.
For primary bibliographic entry see Field 5G.
W78-04117

A CRITICAL EVALUATION OF THE NON-RADIOLOGICAL ENVIRONMENTAL TECHNICAL SPECIFICATION - VOL. I. PROGRAM DESCRIPTION, SUMMARY AND RECOMMENDATIONS.
Oak Ridge National Lab., TN. Environmental Sciences Div.
S. M. Adams, P. A. Cunningham, D. D. Gray, K. D. Kumar, and A. J. Witten.
Available from the National Technical Information Service, Springfield, VA 22161 as O2.NL/NUREG/TM-69. Price codes: A04 in paper copy, A01 in microfiche. Report ORNL/NUREG/TM-69, Vol 1, June 1977, 46 p, 7 tab, 11 ref. W7405-eng-26, ERDA 40-550-75 (Interagency agreement).

Descriptors: *Environment effects, Specifications, Monitoring, Ecology, Powerplants, *Nuclear powerplants, Evaluation, Assessments, *Hydrothermal monitoring, *Ecological monitoring.

This report includes a summary of the screening phase of a study conducted as part of the environmental Technical Specification program for eight nuclear power plants. An evaluation of the adequacy of hydrothermal and ecological monitoring data for each plant is given as are the summary and recommendations resulting from a detailed examination of three nuclear power plants. Due to sporadic operating histories, several plants were

Field 6—WATER RESOURCES PLANNING

Group 6G—Ecologic Impact Of Water Development

eliminated from consideration for more in-depth analysis. Results of this study are expected to feed back into the present environmental assessment process and provide a basis for predicting potential impacts at future facilities. Fixed thermograph networks were considered to provide the best method for continuous environmental surveillance and for constructing probabilistic isotherm maps. It was suggested that selection of monitoring stations during preoperational periods should involve identification of monitoring areas with comparable physical and chemical characteristics which directly affect the type of biological community within the area. (See also W78-04131) (Chilton-ORNL)
W78-04130

A CRITICAL EVALUATION OF THE NON-RADIOLOGICAL ENVIRONMENTAL TECHNICAL SPECIFICATIONS - VOL. 4, SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1, Oak Ridge National Lab., TN. Environmental Sciences Div.
S. M. Adams, P. A. Cunningham, D. D. Gray, and K. D. Kumar.
Available from the National Technical Information Service, Springfield, VA 22161 as ORNL/NUREG/TM-72, Price code: A05 in paper copy, A01 in microfiche. Report ORNL/NUREG/TM-72, Vol 4 of ORNL/NUREG/TM-69, June 1977, 83 p, 36 fig, 9 tab, 37 ref. W-7405-eng-26 Inter agency agreement No. ERDA-40-550-75.

Descriptors: *Environmental effects, *Monitoring, Ecology, Model studies, Sampling, Plankton, Benthos, Nekton, *San Onofre Nuclear Generating Station(Calif), Powerplants, *Nuclear powerplants, California.

Material in this report includes an analysis of hydrothermal and ecological monitoring data collected in 1975 for San Onofre Nuclear Generating Station, Unit 1. Included in the hydrothermal analysis is a discussion of models used plume predictions prior to plant operation and an evaluation of present hydrothermal monitoring. It was concluded that the present program meets requirements of the Technical Specifications. Evaluation of the ecological monitoring program reviewed the sampling program designed to monitor planktonic, benthic, and nektonic communities in the vicinity. It was concluded that the frequency of sampling of all trophic levels is inadequate and that sampling should be extended into offshore areas. (See also W78-04130) (Chilton-ORNL)
W78-04131

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE KEWAUNEE NUCLEAR POWER PLANT SITE, Argonne National Lab. IL.
For primary bibliographic entry see Field 5C.
W78-04132

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - THE QUAD-CITIES NUCLEAR POWER STATION SITE, Argonne National Lab., IL.
For primary bibliographic entry see Field 5C.
W78-04133

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES, THE ZION NUCLEAR POWER STATION SITE, Argonne National Lab., IL.
For primary bibliographic entry see Field 5C.
W78-04134

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - PRAIRIE ISLAND NUCLEAR GENERATING PLANT SITE, Argonne National Lab., IL.
For primary bibliographic entry see Field 5C.
W78-04135

AN EVALUATION OF ENVIRONMENTAL DATA RELATING TO SELECTED NUCLEAR POWER PLANT SITES - A SYNTHESIS AND SUMMARY WITH RECOMMENDATIONS, Argonne National Lab., IL.
For primary bibliographic entry see Field 5C.
W78-04136

ENVIRONMENTAL IMPACTS OF THE GENERATION OF ELECTRICITY IN THE PACIFIC NORTHWEST. VOLUME II. Equitable Environmental Health, Inc., Woodbury, NY.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 097, Price codes: A10 in paper copy, A01 in microfiche. Prepared for Bonneville Power Administration, Portland, OR, September 1976. 189 p, 9 fig, 91 tab. 14-03-6103N.

Descriptors: *Power plants, *Environmental effects, *Pacific Northwest U.S., *Thermal power plants, *Environmental effects, *Pacific Northwest U.S., *Thermal power plants, *Electric power production, Methodology, Air pollution effects, Water pollution effects, Water supply, Land use, Population, Vegetation, Mapping, Regulation, Nuclear power plants, Bonneville power administration, Energy parks.

This study describes and quantifies where possible the environment impacts of all existing plants and various scenarios for planned thermal electrical generating facilities through 1995 in the Pacific Northwest. It includes extraction, processing and transportation as well as fuel conversion for the generating facilities. Evaluation of the regional impact potential of power generation is based on air quality, water quantity/quality, population/land use, and flora variables. Subregions of homogeneous impact susceptibility and related characteristics are defined and mapped. These maps and regulatory considerations are the basis for maps outlining geographical areas of constraints on development of power generation. The impact of six scenarios for meeting power needs over the next 20 years in the Bonneville Power Administration (BPA) service area are tabulated. The evaluation of environmental impact of each scenario addresses incremental, synergistic, long term cumulative, and threshold effects of air, water, and solid residuals and effects of population and land disturbance. The subregional analysis is followed by an evaluation of the impacts of power generation scenarios on the entire region. It includes an analysis of the comparative impacts of energy parks and dispersed sites, and varying numbers of larger and smaller power generation units of the same capacity. (Nessa-NC)
W78-04149

REPORT OF A WORKSHOP ON THE IMPACT OF THERMAL POWER PLANT COOLING SYSTEMS ON AQUATIC ENVIRONMENTS. Sigma Research Inc., Richland, WA.
For primary bibliographic entry see Field 5C.
W78-04155

THE CONNECTICUT RIVER ECOLOGICAL STUDY, THE IMPACT OF A NUCLEAR POWER PLANT. American Fisheries Society, Bethesda, MD.
For primary bibliographic entry see Field 5C.
W78-04174

HYDROGRAPHY, Essex Marine Lab., CT.
For primary bibliographic entry see Field 5C.
W78-04183

7. RESOURCES DATA

7A. Network Design

AN EXAMPLE OF REGIONAL CO-OPERATION FOR IMPROVING THE HYDROLOGICAL AND METEOROLOGICAL INFORMATION, World Meteorological Organization, Managua (Nicaragua). Central American Hydrometeorological Project.

E. Basso, A. Arriagada, H. Neira, and M. P. Delgado.

In: Design of Water Resources Projects With Inadequate Data, Volume 2; Proceedings of the Madrid Symposium, June 1973: International Association of Hydrological Sciences Publication No. 108 (2 Vol.), p 35-57, 1974. 12 fig, 20 ref.

Descriptors: *Training, *Hydrology, *Foreign countries, *Networks, Data collections, Hydrologic data, Instrumentation, Publications, Information exchange, Meteorological data, Meteorology, Discharge measurement, Precipitation(Atmospheric), Sediment discharge, Floods, Rainfall, Water balance, Sediment transport, *Central America, *Costa Rica, *El Salvador, *Guatemala, *Honduras, *Nicaragua, *Panama.

The Central American Hydrometeorological Project initiated in September 1967 represents a co-operative effort among the countries of the Central American Isthmus (Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama) and the United Nations Development Programme. The World Meteorological Organization acts as executive agency. Project objectives are: (1) installation of a basic network of meteorological and hydrological stations; (2) collection, processing, and publication of the data; (3) training of personnel by means of courses, fellowships, or through technical publications and manuals; and (4) the institutional strengthening of the meteorological and hydrological services in the area. Important Project activities have been the testing of new equipment used in developed countries in order to study their application to the characteristics and tropical climate of the area, and the development and application of methods for meteorology, hydrology and sediment studies with limited information. It was concluded that their use in other areas with similar conditions can be useful and that regional cooperation can be one effective means for coping with inadequate data through the pooling of individual countries' efforts. (See also W78-03783) (Humphreys-ISWS)
W78-03785

7B. Data Acquisition

LANDSAT LINEAR TREND ANALYSIS: A TOOL FOR GROUNDWATER EXPLORATION IN NORTHERN ARKANSAS, Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 4B.
W78-03752

DEFINING REACTIONS AND MASS TRANSFER IN PART OF THE FLORIDAN AQUIFER, Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W78-03770

A PROCEDURE FOR DETECTION AND MEASUREMENT OF INTERFACES IN REMOTELY

RESOURCES DATA—Field 7

Evaluation, Processing and Publication—Group 7C

ACQUIRED DATA USING A DIGITAL COMPUTER.

National Aeronautics and Space Administration, Houston, TX. Lyndon B. Johnson Space Center. K. H. Faller.

Available from the National Technical Information Service, Springfield, VA 22161 as NASA TR R-472, Price codes: A03 in paper copy, A01 in microfiche. NASA Technical Report No. NASA TR R-472, July 1977. 31 p, 12 fig, 4 tab, 3 ref.

Descriptors: *Remote sensing, *Tides, *Interfaces, Measurement, Shoreline, Detection, Data acquisition, Multispectral scanner.

A technique developed and evaluated for the detection and measurement of surface feature interfaces in remotely acquired data is described. A computer implementation of this technique has been effected to automatically process categorized data derived from various sources such as the Landsat multispectral scanner and other scanner-type sensors. The basic elements of the operational theory of the technique are described together with details of the procedure. An example application of the technique to the analysis of tidal shoreline length is given with a breakdown of manpower requirements. The technique as applied to Landsat multispectral scanner data is evaluated with respect to accuracy and precision. (Sinha-OEIS) W78-03865

REMOTE SENSING OF OIL POLLUTION AT THE SEA SURFACE I. REVIEW OF REMOTE SENSING METHODS EMPHASIZING RADAR. Netherlands Interdepartmental Working Group on the Application of Remote Sensing, Delft. For primary bibliographic entry see Field 5A. W78-03867

REMOTE SENSING OF OIL POLLUTION AT THE SEA SURFACE II. DAMPING OF WATER WAVES BY AN OIL LAYER AS A POSSIBLE INDICATOR FOR SOLAR OBSERVATIONS. Netherlands Interdepartmental Working Group for the Application of Remote Sensing Techniques, Delft. For primary bibliographic entry see Field 5A. W78-03868

METAMORPHISM OF SNOW AND ICE SINTERING OBSERVED BY TIME LAPSE CINEPHOTOMICROGRAPHY. Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science. For primary bibliographic entry see Field 2C. W78-04007

NUMERICAL PARAMETERS TO IDENTIFY SNOW STRUCTURE. Swiss Federal Inst. for Snow and Avalanche Research, Weissfluhjoch-Davos. For primary bibliographic entry see Field 2C. W78-04008

ON THE DIELECTRIC CONSTANT OF WET SNOW. Innsbruck Univ. (Austria). Physikalisches Inst. For primary bibliographic entry see Field 2C. W78-04012

CREEP-INDUCED CHANGES IN STRUCTURE AND DENSITY OF SNOW. Moscow State Univ. (USSR). Snow Avalanche Problem Lab. For primary bibliographic entry see Field 2C. W78-04015

CONTINUOUS MEASUREMENTS OF DEFORMATIONS ON AN AVALANCHE SLOPE, ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FORT COLLINS, CO. For primary bibliographic entry see Field 2C. W78-04022

STUDIES OF SUBTERRANEAN WATERS: 25. METHODS OF COLLECTING INTERSTITIAL SUBTERRANEAN WATERS, (IN FRENCH). Centre National de la Recherche Scientifique, Moulis (France). Lab. Souterrain. Claude Bou. Ann Speleol. 29(4), p 611-620, 1974.

Descriptors: Methodology, Groundwater, Water wells, *Fauna sampling, Interstitial waters, *Mediterranean Sea, Rivers, *Subterranean waters.

Two method of fauna collection in underground waters are described. The first known as 'methode des sondages tubes Bou-Rouch' is intended for the study of the under-flow of rivers. Since its preliminary description in 1967, it has been intensely used in the areas around the Mediterranean Sea. The second, described by Cvetkov in 1968, is intended for the study of the fauna of wells. The respective advantages of the 2 methods and the extension of their use are discussed.—Copyright 1975, Biological Abstracts, Inc. W78-04024

MULTIVARIATE DATA ANALYSIS AS A TOOL FOR DAY-BY-DAY AVALANCHE FORECAST, Grenoble Univ. (France). Lab. de Mecanique des Fluides. For primary bibliographic entry see Field 2C. W78-04031

HOW TO DESIGN AND SELECT A (WASTE WATER) SAMPLER, Sirco Products Ltd., Vancouver (British Columbia). For primary bibliographic entry see Field 5A. W78-04068

ASSESSMENT OF WATER QUALITY STATUS AND TRENDS IN MINNESOTA BY REMOTE SENSING TECHNIQUES, Minnesota Univ., Minneapolis. For primary bibliographic entry see Field 5A. W78-04105

WATER RESEARCH INSTRUMENTATION: 2. For primary bibliographic entry see Field 5A. W78-04153

7C. Evaluation, Processing and Publication

LANDSAT LINEAR TREND ANALYSIS: A TOOL FOR GROUNDWATER EXPLORATION IN NORTHERN ARKANSAS, Arkansas Univ., Fayetteville. Water Resources Research Center. For primary bibliographic entry see Field 4B. W78-03752

FIELD GUIDE TO THE GEOLOGY OF THE DURHAM TRIASSIC BASIN, NORTH CAROLINA, Geological Survey, Raleigh, NC. Water Resources Div.; and Campbell Coll., Buie's Creek, NC. For primary bibliographic entry see Field 2J. W78-03760

DIGITAL MODEL OF THE ARIKAREE AQUIFER NEAR WHEATLAND, SOUTHEASTERN WYOMING, Geological Survey, Cheyenne, WY. Water Resources Div. For primary bibliographic entry see Field 2F. W78-03761

WATER-RESOURCES INVESTIGATIONS IN NORTH DAKOTA, 1976. Geological Survey, Bismarck, ND. Water Resources Div. Water-Resources Investigations in North Dakota Folder, 1977. 1 sheet.

Descriptors: *Water resources, Investigations, *Inter-agency cooperation, *North Dakota, Surveys, Planning, Hydrologic data, Basic data collections, Streamflow, Groundwater, Water quality, On-site investigations, Dissolved solids, Water level fluctuations, Bibliographies, Networks, *Maps, Cooperative water-studies program.

Water-resources studies and investigations in North Dakota made by the U.S. Geological Survey in cooperation with State and local agencies are summarized. A bibliography of selected material concerning these investigations is included. The investigations include collections of basic information through a hydrologic data network, areal hydrologic or interpretive studies, and research projects. The hydrologic data network consists of primary, secondary, and water-management streamflow stations; groundwater observation wells; and water-quality observation sites. Small State maps show principal sources of ground water, average annual precipitation, average annual runoff, discharge of the principal rivers, and the dissolved solids in surface waters. A map, scale 50 mi to the in, shows by symbols, numbers, and colored outline the hydrologic data network and investigations in North Dakota as of September 1976. (Woodard-USGS) W78-03764

WATER-RESOURCES INVESTIGATIONS IN ARIZONA, 1977. Geological Survey, Tucson, AZ. Water Resources Div. Water-Resources Investigations in Arizona Folder, 1977. 1 sheet.

Descriptors: *Water resources, Investigations, *Inter-agency cooperation, *Arizona, Surveys, Planning, Hydrologic data, Basic data collections, Precipitation(Atmospheric), Flood plains, Streamflow, Runoff, Reservoirs, Groundwater, Water quality, On-site investigations, Dissolved solids, Water level fluctuations, Bibliographies, Networks, *Maps, Cooperative water-studies program.

Water-resources studies and investigations in Arizona made by the U.S. Geological Survey in Cooperation with State and local agencies are summarized. A bibliography of selected material concerning these investigations is included. The investigations include collections of basic information through a hydrologic data network, areal hydrologic or interpretive studies, and research projects. The hydrologic data network consists of primary, secondary, and water-management streamflow stations; groundwater observation wells; and water-quality observation sites. Small State maps show average annual precipitation, flood prone areas, storage in principal reservoirs, water quality, principal sources of ground water, discharge of the principal rivers, and change in water levels in aquifers of developed areas. A map, scale 50 mi to the in, shows by symbols, numbers, and colored outline the hydrologic data network and investigations in Arizona as of January 1977. (Woodard-USGS) W78-03765

Field 7—RESOURCES DATA

Group 7C—Evaluation, Processing and Publication

PROGRAM OBJECTIVES FOR THE NATIONAL WATER DATA EXCHANGE (NAWDEX) FOR FISCAL YEAR 1978,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards.
Open-file report 77-791, 1977. 8 p.

Descriptors: *Data storage and retrieval, *Information exchange, *Programs, *Project planning, *Data processing, Data transmission, Systems analysis, Bibliographies, Water resources, Training, *Data collections, *National Water Data Exchange(Nawdex), Storet, Watstore, Wrsic, Eds, Endex, Oasis, Data services, Water data sources directory, Master water data index.

This report presents the program objectives for the National Water Data Exchange (Nawdex) for Fiscal Year 1978, October 1, 1977 to September 30, 1978. Objectives covered include Nawdex membership, membership participation, Nawdex services, identification of sources of water data, the indexing of water data, systems development and implementation, training, recommended standards for the handling and exchange of water data, and program management. The report provides advance information on Nawdex activities, thereby, allowing the activities to be better integrated into the planning and operation of programs of member organizations. (Woodard-USGS)
W78-03767

GROUND-WATER LEVELS IN WYOMING, 1976,
Geological Survey, Cheyenne, WY. Water Resources Div.
W. C. Ballance, and P. B. Freudenthal.
Open-file report 77-686, August 1977. 187 p, 21 fig, 5 ref.

Descriptors: *Groundwater, *Water levels, *Observation wells, *Water level fluctuations, *Wyoming, Data collections, Hydrographs, Water wells, Sites, Water utilization, Irrigation, Municipal water, Aquifers.

Ground-water levels are measured periodically in a network of about 280 observation wells in Wyoming to record changes in ground-water storage. The areas of water-level observation are mostly where ground water is used in large quantities for irrigation or municipal purposes. This report contains maps showing location of observation wells and water-level changes from 1976 to 1977. Well history, highest and lowest water levels, and hydrographs for most wells also are included. The program of groundwater observation is conducted by the U.S. Geological Survey in cooperation with the Wyoming State Engineer and the city of Cheyenne. (Woodard-USGS)
W78-03768

BIBLIOGRAPHY OF REPORTS BY MEMBERS OF THE U.S. GEOLOGICAL SURVEY ON THE WATER RESOURCES OF ALASKA, 1870 THROUGH 1976,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 10C.
W78-03778

WATER RESOURCES DATA FOR IDAHO, WATER YEAR 1976.
Geological Survey, Boise, ID. Water Resources Div.
Water-Data Report ID-76-1, November 1977. 634 p, 21 fig, 1 tab.

Descriptors: *Idaho, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1976 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 192 stations; stage only records for 2 gaging stations; stage for 6 lakes; contents for 25 lakes and reservoirs; water-quality for 91 gaging stations, 42 partial-record stations, 2 lakes, and 222 wells; and water levels for 6 observation wells. Also included are data for 58 crest-stage partial-record stations and 180 low-flow partial record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Washington. (Woodard-USGS)
W78-03782

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 2. EASTERN WASHINGTON.

Geological Survey, Tacoma, WA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 887. Price codes: A16 in paper copy, A01 in microfiche. Water-Data Report WA-76-2, October 1977. 344 p, 18 fig.

Descriptors: *Washington, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Eastern Washington.

Water resources data for the 1976 water year for Washington, consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells and springs. This report, in two volumes, contains discharge records for 248 gaging stations, stage only records for 3 gaging stations, stage and contents for 44 lakes and reservoirs, water quality for 124 stations and 8 lakes, and water levels for 108 observation wells. Also included are 172 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Washington. (Woodard-USGS)
W78-03781

WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976—VOLUME 1. WESTERN WASHINGTON.

Geological Survey, Tacoma, WA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 886. Price codes: A18 in paper copy, A01 in microfiche. Water-Data Report WA-76-1, October 1977. 403 p, 21 fig.

Descriptors: *Washington, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites, Western Washington.

Water resources data for the 1976 water year for Washington, consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells and springs. This

report, in two volumes, contains discharge records for 248 gaging stations, stage only records for 3 gaging stations, stage and contents for 44 lakes and reservoirs, water quality for 124 stations and 8 lakes, and water levels for 108 observation wells. Also included are 172 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Washington. (Woodard-USGS)
W78-03782

DESIGN OF WATER RESOURCES PROJECTS WITH INADEQUATE DATA, VOLUME 2.

International Association of Scientific Hydrology, Gentbrugge (Belgium).
For primary bibliographic entry see Field 4A.
W78-03783

WATER RESOURCES PROJECTS IN NIGERIA AND THE HYDROLOGICAL DATA EMPLOYED IN THEIR PLANNING AND DEVELOPMENT,

Ife Univ. (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W78-03784

GEOHYDROLOGICAL STUDIES IN SMALL AREAS WITHOUT SYSTEMATIC DATA,

For primary bibliographic entry see Field 4B.

W78-03787

METHODS OF ANALYSING DEFICIENT DISCHARGE DATA IN ARID AND SEMI-ARID ZONES FOR THE DESIGN OF SURFACE WATER UTILIZATION,

Tahal Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 4A.
W78-03788

RELATION OF HYDROLOGICAL PROGRAMS OF THE CENTER OF HYDROGRAPHIC STUDIES FOR COMPLETE STUDIES OF HYDRAULIC RESOURCES WITH INSUFFICIENT DATA,

For primary bibliographic entry see Field 2A.

W78-03791

OBJECTIVE CRITERIA TO DECLARE A SERIES OF DATA SUFFICIENT FOR TECHNICAL PURPOSES,

For primary bibliographic entry see Field 2A.

W78-03795

SOME CRITERIA USED IN HYDROLOGIC STUDIES WITH INADEQUATE DATA,

For primary bibliographic entry see Field 2A.

W78-03796

DETERMINATION OF HYDROLOGICAL CHARACTERISTICS IN POINTS WITHOUT DIRECT HYDROMETRIC DATA,

World Meteorological Organization, Bogota (Columbia); and United Nations Development Program, Bogota (Columbia).
For primary bibliographic entry see Field 4A.
W78-03797

FLOOD ESTIMATION BY DETERMINATION OF REGIONAL PARAMETERS FROM LIMITED DATA,

For primary bibliographic entry see Field 4A.

W78-03805

ENGINEERING WORKS—Field 8

Hydraulics—Group 8B

COMPUTERIZED ANALYSIS OF STREAM ALGAE,
Uppsala Univ. (Sweden).
For primary bibliographic entry see Field 5C.
W78-03815

IFYGL TEMPERATURE TRANSECTS: TEMPERATURE DISTRIBUTIONS ACROSS THREE SECTIONS OF LAKE ONTARIO CONTINUOUSLY TRANSVERSED OVER FOUR-DAY INTERVALS IN JULY, AUGUST, AND OCTOBER 1972,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W78-03841

FLOOD PLAIN INFORMATION: PAMUNKEY RIVER, HANOVER COUNTY, VIRGINIA.
Army Engineer District, Norfolk, VA.
For primary bibliographic entry see Field 4A.
W78-03902

FLOOD PLAIN INFORMATION: ALLEGHENY RIVER, ARMSTRONG COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03903

FLOOD PLAIN INFORMATION: ALLEGHENY RIVER, NEW KENSINGTON, ARNOLD, LOWER BURRELL AND ALLEGHENY TOWNSHIP, WESTMORELAND COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03904

FLOOD PLAIN INFORMATION: OHIO, ALLEGHENY, MONONGAHELA AND YOUGIOGHENY RIVER, ALLEGHENY COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03905

FLOOD PLAIN INFORMATION: CONEMAUGH AND LITTLE CONEMAUGH RIVERS, STONY AND BENS CREEKS, CITY OF JOHNSTOWN AND VICINITY, CAMBRIA AND SOMERSET COUNTIES, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03906

FLOOD PLAIN INFORMATION: PETERS CREEK, JEFFERSON BOROUGH, ALLEGHENY COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03907

FLOOD PLAIN INFORMATION: FRENCH CREEK, COCHRANTON, CRAWFORD COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03908

FLOOD PLAIN INFORMATION: CLARION RIVER AND SILVER CREEK, JOHNSONBURG, ELK COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03909

FLOOD PLAIN INFORMATION: HARE AND BEAR CREEKS, CORRY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03910

FLOOD PLAIN INFORMATION: MONONGAHELA RIVER, CALIFORNIA, COAL CENTER, AND WEST BROWNSVILLE, WASHINGTON COUNTY, PENNSYLVANIA.
Army Engineer District, Pittsburgh, PA.
For primary bibliographic entry see Field 4A.
W78-03911

FLOOD PLAIN INFORMATION: BLACKSTONE RIVER, CUMBERLAND, LINCOLN, CENTRAL FALLS, AND PAWPUCKET, RHODE ISLAND.
Army Engineer District, Waltham, MA.
For primary bibliographic entry see Field 4A.
W78-03912

FLOOD PLAIN INFORMATION: WEST BRANCH SUSQUEHANNA RIVER (EAST), LYCOMING COUNTY, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 4A.
W78-03913

FLOOD PLAIN INFORMATION: FRANKSTOWN BRANCH JUNIATA RIVER, WILLIAMSBURG, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 4A.
W78-03914

FLOOD HAZARD REPORT: SHICKSHINNY CREEK, LUZERNE COUNTY, PENNSYLVANIA.
Army Engineer District, Baltimore, MD.
For primary bibliographic entry see Field 4A.
W78-03915

FLOOD PLAIN INFORMATION: BIG SANDY RIVER, WAYNE COUNTY, WEST VIRGINIA.
Army Engineer District, Huntington, WV.
For primary bibliographic entry see Field 4A.
W78-03916

FLOOD HAZARD INFORMATION: BUFFALO CREEK, LOGAN COUNTY, WEST VIRGINIA—POST DISASTER CONDITIONS.
Army Engineer District, Huntington, WV.
For primary bibliographic entry see Field 4A.
W78-03917

A COMPUTERIZED METHOD FOR ABSTRACTING AND EVALUATING ENVIRONMENTAL IMPACT STATEMENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 6G.
W78-03970

8. ENGINEERING WORKS

8B. Hydraulics

SYNTHETIC UNIT HYDROGRAPH TECHNIQUE FOR THE DESIGN OF FLOOD ALLEVIATION WORKS IN URBAN AREAS.
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W78-03802

PROSPECTS FOR GEOTHERMAL ENERGY APPLICATIONS AND UTILIZATION IN CANADA,
Toronto Univ. (Ontario). Inst. for Aerospace Studies.
For primary bibliographic entry see Field 4B.
W78-03845

PRELIMINARY ASSESSMENT OF A GEOTHERMAL ENERGY RESERVOIR FORMED BY HYDRAULIC FRACTURING,
Los Alamos Scientific Lab., NM.

H. D. Murphy.
Society of Petroleum Engineers Journal, Vol. 17, No. 4, p 317-326, August, 1977. 11 fig, 18 ref.

Descriptors: *Hydraulic conductivity, *Geothermal studies, *Thermal conductivity, Temperature, Pore pressure, Boreholes, Logging(Recording), Subsurface investigations, Physical properties, Granites, Permeability, Compressibility, Density, Drilling, Wells, *Hydraulic fracturing, In-situ measurements, Flowing temperature logs, Fracture extension pressure, Fracture growth, Fracture propping, Heat exchange system, Granitic rocks, Geothermal wells.

Two boreholes, each 3 kilometers in depth were drilled in northern New Mexico to extract geothermal energy from hot, dry rock. Both boreholes were in granitic rock and hydraulically fractured to establish a flow connection between them. Fracture to borehole intersection locations were determined for flowing temperature logs. In-situ measurements of rock permeability and compressibility displayed a strong dependence on pore pressure. An estimate of the minimum horizontal earth stress was derived from fracture extension pressures and found to be one-half the overburden stress load. Fracture growth was simple to achieve in the low-permeability granitic rock and the fractures appeared to be 'self-propagated.' The present connection has a large file that probably cannot be reduced to a useful level. Redrilling to intersect directly one of the fractures will be prerequisite to the implementation of a heat exchange system. (Heiss-NWWA)
W78-03853

STUDY AND TESTING OF DIRECT CONTACT HEAT EXCHANGERS FOR GEOTHERMAL BRINES: FINAL REPORT,
DSS Engineers, Inc., Ft. Lauderdale, FL.
For primary bibliographic entry see Field 8G.
W78-03858

DEVELOPMENT OF AN ASSESSMENT METHODOLOGY FOR GEOPRESSED ZONES OF THE UPPER GULF COAST BASED ON A STUDY OF ABNORMALLY PRESSURED FIELDS IN SOUTH TEXAS,
Southwest Research Inst., San Antonio, TX.

R. K. Swanson, P. Oetking, J. S. Osoba, and R. C. Hagens.
Available from the National Technical Information Service, Springfield, VA 22161 as COO-2687-5, August, 1976. 103 p, 52 fig, 26 ref, 3 append.

Descriptors: *Geothermal studies, *Thermal power, Thermal water, Temperature, Pressure, Aquifers, Natural gas, Exploration, Methodology, Assessments, Sands, Shales, Faults(Geology), Permeability, Depth, Compaction, Gulf Coastal Plain, *Texas, *Geopressed zones.

Detailed study of the producing gas fields in south Texas has identified a total of 47 abnormally pressured zones in six-county area including Hidalgo, Brooks, Cameron, Willacy, Kenedy, and Live Oak Counties. The abnormal pressures are believed to be the result of arrested compaction of shale with increasing depth of burial, as a result of impaired subsurface drainage; increased temperature gradients are believed to be caused by the insulating properties of the undercompacted shale.

Field 8—ENGINEERING WORKS

Group 8B—Hydraulics

A methodology for assessing these zones was developed, and the depths and temperatures of the south Texas fields were determined. The question of fluid deliverability for thermal power was found to be the critical factor in determining the potential of a given area. Permeability values range from less than 0.03 md to more than 8 md, with an average of all fields near 1 md. Permeability decreases rapidly with depth, thus, the desirable combination of good permeability and high temperature seldom occurs in the study area. Nevertheless, five locations within the area were selected as potential candidates for further evaluation and possible eventual testing for power capability. (Eberle-NWWA) W78-03863

FORCES EXERTED BY WAVES ON A PIPELINE AT OR NEAR THE OCEAN BOTTOM,

California Univ., Berkeley. Hydraulic Engineering Lab.

G. L. Bowie.

Available from the National Technical Information Service, Springfield, VA 22161 as AD-A046 551, Price codes: A09 in paper copy, A01 in microfiche. Published by Army Coastal Engineering Research Center, Fort Belvoir, Va., Technical Paper No. 77-11, October 1977. 177 p, 65 fig, 1 tab, 7 append. DACW72-74-C-0004.

Descriptors: *Pipelines, *Oil industry, *Water resources development, *Waves(Water), Pollution abatement, *Outer Continental Shelf, Ocean bottom, Wave forces, Lift forces.

The wave-induced forces on a submarine pipeline near the ocean floor consist of several components—inelastic forces, drag forces, lift forces, and under some conditions, eddy-induced forces. For a pipeline touching the bottom, or at a small clearance above the bottom, the lift force is the predominant force in the vertical direction. The experimental results of this investigation, however, show that this steady-flow lift model is inadequate for wave-induced oscillatory flows. For pipelines at small clearances above the bottom, viscous effects near the bottom clearance constriction may result in lift forces acting in both the upward and downward directions during different parts of the wave cycle. In addition, the maximum positive and negative lift forces may not correspond to the positions of maximum horizontal velocities in the wave cycle. Quantitative relationships between these unknown lift force parameters and various dimensionless parameters defining the wave and pipe conditions were found. These relationships exhibited good correlation for all wave conditions, bottom clearances, pipe diameters, and orientation angles. (Sinha—OEIS) W78-03873

DESIGN OF OPTIMAL WATER DISTRIBUTION SYSTEMS,

Technion-Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.

F. Alperovits, and U. Shamir.

Water Resources Research, Vol 13, No 6, p 885-900, December 1977. 6 fig, 9 tab, 13 ref, 2 append.

Descriptors: *Water distribution(Applied), *Branching networks, *Pipelines, *Design, *Economic efficiency, *Linear programming, *Optimization, Cost minimization, Gradient method, Methodology, Demand, Operations research, Decision making, Constraints, Flow, Capital costs, Operating costs, Hierarchical decomposition, Postoptimality analysis, Pumping, Equations, Mathematical models.

A method called linear programming gradient (LPG) is presented, by which the optimal design of a water distribution system can be obtained. The system is a pipeline network which delivers known demands from sources to consumers and which may contain pumps, valves, and reservoirs.

System operation under each of a set of demand loadings is considered explicitly in the optimization. The decision variables thus include design parameters (pipe diameters, pump capacities, and reservoir elevations) and operational parameters (the pumps to be operated and the valve settings for each of the loading conditions). The objective function, to be minimized, reflects the overall cost capital plus present value of operating costs. The constraints are in the form of demands to be met and pressures at selected nodes in the network to be within specified limits. The solution is obtained via a hierarchical decomposition of the optimization problem. The primary variables are the flows in the network. For each flow distribution, the other decision variables are optimized by linear programming. Postoptimality analysis of the linear program provides the information necessary to compute the gradient of the total cost with respect to changes in the flow distribution. The gradient is used to change the flows so that a (local) optimum is approached. The method has been implemented in a computer program, and solved examples are presented. (Bell-Cornell) W78-03997

SNOW MECHANICS SYMPOSIUM.

International Association of Scientific Hydrology, Gentbrugge (Belgium).

For primary bibliographic entry see Field 2C.

W78-03998

8C. Hydraulic Machinery

CORROSION SUSCEPTIBILITIES OF VARIOUS METALS AND ALLOYS IN SYNTHETIC GEOTHERMAL BRINES,

California Univ., Davis. Dept. of Mechanical Engineering.

For primary bibliographic entry see Field 8G.

W78-03852

FIBERGLASS CASING AND SCREEN FULFILLS WELLS' NEEDS,

For primary bibliographic entry see Field 8G.

W78-03854

REMOVING H2S FROM GEOTHERMAL STEAM,

Coury and Associates, Inc., Lakewood, CO.

For primary bibliographic entry see Field 5G.

W78-03855

GEOTHERMAL HOT WATER PUMP.

Lear Motors Corp., Reno, NV.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-261 741, Price codes: A06 in paper copy, A01 in microfiche. Report No NSF/RA-760379, May, 1976. 144 p, 33 fig, 5 tab. Issued as Report No LMC 760504-A.

Descriptors: *Geothermal studies, *Pumps, *Thermal water, Brines, Pump testing, Electric motors, Rotors, Stators, Generators, Electric cables, Electric insulation, Materials, Bearings, Cooling, Performance, *Geothermal fluid pumps.

The development of a high-speed submersible pump which can operate in harsh geothermal environments is described in this report. Capable of functioning at depths in excess of 1,000 feet and at temperatures up to 450 degrees F (232 degrees C), the system is specially designed to circulate hot brine in a sealed circulation loop to prevent flashing of the brine into steam. Motor and pump design are discussed, and results of all testing performed on the prototype system are presented. The key element in this system is the electric motor. It was originally designed to produce a rated output of 400 hp at 11,600 rpm. Electromagnetic efficiency was predicted at 85.7% and overall efficiency at 72.3%. A generator failure prevented completion

of high-speed tests, but full load tests at 7,400 rpm indicate that the motor is capable of rated performance at full speed, with slightly higher efficiencies than predicted. (Eberle-NWWA) W78-03859

DRILLING FOR ENERGY RESOURCES.

National Research Council, Washington, DC. Ad Hoc Committee on Technology of Drilling for Energy Resources.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-259 206, Price codes: A05 in paper copy, A01 in microfiche. Report No. NSF/RA-760/95, 1976. 67 p, 17 fig, 5 tab, 25 ref.

Descriptors: *Drilling, *Energy, *Resource development, Oil, Natural gas, Thermal power, Mining, Coal mines, Shafts(Excavations), Nuclear energy, Exploration, Equipment, Offshore platforms, Technology, Costs, Government supports, Drilling rate, Downhole motors.

Because drilling is integral to the exploration, development, and production of most energy sources, the limitations of drilling technology which currently exist restrict the rate at which new supplies of energy can be found, extracted, and delivered. This report provides an overview of the U.S. drilling industry, describing the equipment and techniques for recovering oil, natural gas, coal, shale oil, nuclear fuels, and geothermal energy. In addition, it suggests particular areas in which government assistance would be valuable in augmenting present research and development efforts of private industry, as well as a rationale for such government involvement. Particular issues addressed include: (1) developing downhole motors; (2) training of drilling workers and engineers; (3) geothermal energy recovery; (4) economic risks of technology development and; (5) commercialization of new mining methods. (Eberle-NWWA) W78-03861

ANALYSIS OF INFORMATION SYSTEMS FOR HYDROPOWER OPERATIONS, - EXECUTIVE SUMMARY,

Jet Propulsion Lab., Pasadena, CA.

R. L. Sohn, L. Becker, J. Estes, D. Simonett, and W. Yeh.

Report JPL 5040-43, RTOP 777-30-01, September 1976, 44 p, 5 fig, 7 tab. NASA NAST-100.

Descriptors: *Water resources, *Management, Watershed management, Flow, *Systems analysis, Forecasting, Hydroelectric power, Meteorology, Energy, *Information systems, Hydrometeorology.

The operations of hydropower systems were analyzed, with emphasis on water resource management, to determine how aerospace derived information system technologies could be used to increase energy output. Results indicated that the major energy loss mechanism is the spillage of water - a forced release of water when the power pool is full and inflows are greater than turbine capacity. It was concluded that hydropower output could be increased through use of information systems that provide increased anticipation times and accuracies for high inflow events. A hydrologic model would be required for the short term inflow forecasting process. Sensor and data handling system capabilities are reviewed and compared to the requirements, and an improved information system concept is recommended. (Chilton-ORNL) W78-04107

LEARN MORE ABOUT VARIABLE SPEED PUMPING/2,

M. Gottliebson.

Water and Wastes Engineering, Vol 14, No 10, p 58-59, 62-64, 68, 90, October, 1977. 27 fig.

ENGINEERING WORKS—Field 8

Fisheries Engineering—Group 81

Descriptors: *Pumping, *Pumps, *Hydraulic machinery, *Analytical techniques, *Flow control, High flow, Head loss, Flow characteristics, Equipment, Waste water treatment.

Various considerations in the selection of pumping systems are discussed with respect to insuring sufficient pumping capacity to discharge the peak influent rate when any single pump in a series is out of service. Various configurations of one-, two-, and three-pump variable-speed pumping systems are discussed. The use of efficiency curves for optimum arrangement of the 'lag' and 'lead' pumps in a variable speed system is described. Basic operating modes include the load sharing mode, in which lead and lag pumps operate at the same speed and discharge rates, and the staggered mode, in which the lead pump operates at maximum speed while the lag pump discharges the portion of influent which exceeds the capacity of the lead pump. The use of a variable-speed controller in staggered pump operation is described. Power requirements and efficiency ratings for load sharing are compared with values for staggering. A series of guidelines for the operation of a variable-speed sewage pumping system are described. Configurations involving the combination of variable-speed pumps with constant-speed at which pump cavitation is produced. Methods of pump failure detection and pumping system control are described. (Schulz-FIRL)
W78-04154

8E. Rock Mechanics and Geology

PRELIMINARY ASSESSMENT OF A GEOTHERMAL ENERGY RESERVOIR FORMED BY HYDRAULIC FRACTURING,

Los Alamos Scientific Lab., NM.
For primary bibliographic entry see Field 8B.
W78-03853

8G. Materials

SOFT FORMATION INSERT BIT RUNS LONGER AND CUTS COSTS.

World Oil, Vol. 185, No. 7, p 93-96, December, 1977. 6 fig, 1 tab.

Descriptors: *Rotary drilling, *Drilling equipment, Costs, Laboratory tests, *Drill bits.

A new premium insert bit selling at competitive insert bit prices has been developed for and tested in softer formations by Reed Tool Company, Houston. Conventional soft formation milled-tooth bits normally drill 10 to 60 feet of hole per hour in recent sedimentary formations; bit life averages about 14 hours in such conditions. Various bit design parameters were evaluated in order to improve upon standard milled-tooth configurations. Both bearing performance and cutting structure were modified extensively. The optimum new design features a 'floating bushing' friction type bearing with conical tungsten carbide inserts. Contrary to expectations, chisel-shaped inserts showed no significant differences in rate of penetration compared with conical inserts, and in fact, suffered a much higher degree of breakage. The cost advantages of this new type bit can only be realized at relatively high speeds (approx. 130 rpm). Tests at 50-70 rpm resulted in lower rates of penetration, which translates into higher drilling costs. (Eberle-NWWA)
W78-03849

CONTINUOUS CHAIN BITS EXCEL IN LAB TESTS.

Drilling Dow, Vol. 39, No. 2, p 58, December, 1977. 1 fig.

Descriptors: *Rotary drilling, *Drilling equipment, Laboratory tests, *Drill bits.

Fixed head versions of Sandia Laboratories' continuous chain drill have been successfully tested and a complete working prototype will be ready for similar laboratory tests later this year. Basically, the bit system consists of 16 cutting surfaces on a chain which is advanced to bring a new surface into position without having to remove the apparatus from the hole. Designed primarily for slim-hole (4 3/4 in. diameter) exploratory drilling applications, the continuous chain drill is expected to increase downhole bit life and penetration rate. The hole is cut by a six-inch-long segment of chain wrapped around sprockets at the bottom of the bit. Plans call for the chain to be advanced by a piston/ratchet driver energized by the pressure of drilling mud in the hole. Assuming that each of the 16 cutting surfaces has one-third the life of a conventional diamond bit, the new system could result in a four-to-fivefold improvement in bit life. Development of the Sandia chain drill is being sponsored by the U.S. Department of Energy's Division of Geothermal Energy. (Eberle-NWWA)
W78-03850

CORROSION SUSCEPTIBILITIES OF VARIOUS METALS AND ALLOYS IN SYNTHETIC GEOTHERMAL BRINES.

California Univ., Davis. Dept. of Mechanical Engineering.

R. B. Davis, and Z. A. Munir.
Journal of Materials Science, Vol. 12, No. 9, p 1909-1913, September, 1977. 6 fig, 1 tab, 12 ref.

Descriptors: *Corrosion, Metallurgy, *Saline water, Corrosion control, Stainless steel, Brines, Titanium, Molybdenum, Steel alloys, Pitting, Nickel, *Geothermal studies, Niobium, Type 304 stainless steel, Type 316 stainless steel, Monel 400, AISI 1010, Passivation, Salton Sea Brines.

The corrosion susceptibilities of various pure metals and alloys were investigated in synthetic geothermal fluids. Rates of corrosion of AISI 1010 steel, types 304 and 316 stainless steels, Monel 400, and nickel were determined at three temperatures (296, 333, and 368 degrees K). Rates of corrosion of molybdenum, niobium, and titanium were determined at 368 degrees K only. Table I details maximum corrosion rates and macroscopic appearances of the first five materials after testing. Weight loss measurements on the 1010 steel showed no tendency for passivation. Type 304 stainless steel appears to undergo an active-passive transition between 333 and 368 degrees K. In the passive state, type 304 has the same corrosion rates as type 316. At 368 degrees K the corrosion rate of pure nickel was 2.5 times that of Monel, which, in turn, was twice that of type 316 stainless steel. The corrosion rates of Mo, Nb, and Ti were less than one mdd at 368 degrees K. No pit formation conclusions can be drawn from tests of such short duration. (Palmer-NWWA)
W78-03852

FIBERGLASS CASING AND SCREEN FULFILLS WELLS' NEEDS.

G. B. Palmer, and D. P. Waltz.
Water Well Journal, Vol. 32, No. 1, p 92-93, January, 1978. 2 fig.

Descriptors: *Well casings, *Well screens, Water wells, On-site investigations, *Fiberglass.

The Fiberglass Resources Corporation of Farmingdale, N.Y., has developed a new type of fiberglass well casing and screen. The well screen (trade name Kwik-Flo) consists of diagonally-crossing fiberglass strands which form an open mesh with diamond-shaped perforations. One-tenth-inch rounded quartz sand grains are coated with epoxy and squeezed into place to fill these perforations with a durable yet porous medium. To test the new casing and screen, Fiberglass Resources Corporation financed an experimental well in the flood plain of the Hocking River near Athens, Ohio. The quantity of water produced by

the test well is comparable to that produced by traditionally screened wells of twice its diameter. Other advantages of the new screen and casing include: (1) elimination of many pollution and corrosion problems; (2) ease of making joints; (3) less time spent in well development, and; (4) sand-free production of water. (Eberle-NWWA)
W78-03854

STUDY AND TESTING OF DIRECT CONTACT HEAT EXCHANGERS FOR GEOTHERMAL BRINES: FINAL REPORT,

DSS Engineers, Inc., Ft. Lauderdale, FL.
W. B. Suratt, and G. K. Hart.

Available from the National Technical Information Service, Springfield, VA 22161 as ORO-4893-1. Price codes: A08 in paper copy, A01 in microfiche. Final Report No ORO-4893-1, January, 1977. 137 p, 29 fig, 17 tab, 67 ref, 6 append.

Descriptors: *Heat exchangers, *Thermal power, *Brines(Geothermal), Heat transfer, Design, Thermal waters, Thermal powerplants, Boilers, Costs, Geothermal studies, *Isobutane, Working fluids, Direct contact heat exchangers, Preheaters, Working fluid loss, Brine pumps.

The object of the work was to assess the technical and economic feasibility of preheating and evaporating a secondary fluid via direct contact with hot geothermal brine for the ultimate purpose of electric power production. Preliminary studies resulted in the selection of isobutane as the working fluid for tests primarily because of the favorable amount of net work produced per pound of geothermal brine and the low amount and cost of working fluid lost in the direct contact heat exchange process. The test apparatus included a separate boiler and preheater, each 6 inches in diameter by 6 feet high. Brine entered the top of each vessel and left the bottom; isobutane entered the bottom of the preheater through a distributor plate to produce .15 inch droplets. No major problems with the system or with isobutane as working fluid were observed, and on the whole, the system demonstrated satisfactory thermal capabilities. Recommendations for future experimentation with such systems focus on cost reduction, determining design criteria for varying size and parameters, and demonstrating the reliability of direct contact heat exchangers in actual field conditions. (Eberle-NWWA)
W78-03858

GEOTHERMAL HOT WATER PUMP.

Lear Motors Corp., Reno, NV.
For primary bibliographic entry see Field 8C.
W78-03859

DRILLING FOR ENERGY RESOURCES.

National Research Council, Washington, DC. Ad Hoc Committee on Technology of Drilling for Energy Resources.
For primary bibliographic entry see Field 8C.
W78-03861

8I. Fisheries Engineering

INSTRUMENTATION TO MONITOR LOCATION OF FISH CONTINUOUSLY IN EXPERIMENTAL CHANNELS,

Bayshore Systems Corp., Springfield, VA.
J. R. Jahoda.
Available from the National Technical Information Service, Springfield, VA 22161 as PB-267 944. Price codes: A07 in paper copy, A01 in microfiche. Ecological Research Series, Report EPA 600/3-77-035, April 1977. 117 p, 5 tab, 54 fig, 47 ref.

Descriptors: *Methodology, Laboratory tests, Laboratory equipment, *Laboratory animals, *Instrumentation, Aquaria, *Monitoring, Water temperature, Equipment, Freshwater fish, Er-

Field 8—ENGINEERING WORKS

Group 81—Fisheries Engineering

vironmental effects, Ecology, Water pollution effects, Path of pollutants, *Location monitors, *Experimental channels, *Fish tracking equipment, *Continuous monitor, *Sonic transmitters, Biotelemetry, Acoustic receiver, Fish location.

This study resulted in the development and construction of equipment to continuously monitor the position and temperature of up to 20 fish in a water channel 486 meters long, 3 meters wide, and 1 meter deep. The system utilized miniature sonic transmitters (tags) operating in the 51 kHz to 366 kHz frequency range which were implanted in 500 gram or heavier fish. The battery operated tags were pulse modulated and designed for over 1 year operational life. Up to 20 individual fish could be monitored. (Katz) W78-03925

MULTIFARIOUS POWER PLANT WATER INTAKE STRUCTURE (MWIS) A DESIGN CONCEPT TO REDUCE THE ENVIRONMENTAL EFFECTS OF COOLING WATER INTAKE STRUCTURES,
New York State Energy Research and Development Authority, New York.
B. Chezar.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-257 201. Price codes: A09 in paper copy, A01 in microfiche. Report No NYSERDA 75/06, July 1976. 164 p, 38 fig, 36 tab, 94 ref.

Descriptors: *Environmental effects, *Engineering structures, Intake structures, Entrainment, Fish, Zooplankton, Powerplants, Design, Impingement.

The MWIS was designed principally for operation in estuarine water bodies (tidal) but can be used in river systems with minor modification. The principal design features include horizontal traveling screens which move in the direction and speed of the ambient water flow, three alternate levels of water withdrawal and adjustable louvers in front of the intake structure. Analysis of the life history, behavior, and distribution of a group of fish and macrozooplankton indicate that use of the MWIS will result in significant reduction of impingement and entrainment of these organisms. (Chilton-ORNL) W78-04048

INVESTIGATIONS ON THE PROTECTION OF FISH LARVAE AT WATER INTAKES USING FINE-MESH SCREENING,
Tennessee Valley Authority, Norris, Div. of Forestry, Fisheries, and Wildlife Development. D. A. Tomljanovich, J. H. Heuer, and C. W. Voigtlander.

TVA Technical Note No B22, February 1977. 53 p, 16 fig, 8 tab, 15 ref.

Descriptors: *Environmental effects, *Intakes, Engineering structures, *Fish larvae, *Screens, Mortality, Design, Impingement.

Two studies (a laboratory investigation using a test flume with variables such as water velocity, intake screen opening, impingement duration, and larval fish species and size and a field study conducted at John Sevier Steam Plant) were conducted to investigate the use of an impinge-release intake screening system. Both studies showed that nearly all sizes of larval fish species in the Tennessee River Valley would be retained by 0.5 mm screen openings but not by 1.0 mm openings. Post-impingement survival was inversely related to duration of impingement and depended upon species, size, and water velocity. It was concluded that protecting larval fish and water intakes with the use of fine mesh screening appears to be a viable concept. (Chilton-ORNL) W78-04049

THE PHYSICAL EFFECTS OF ENTRAINMENT - CURRENT RESEARCH AT ORNL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. S. Sufern.

Available from the National Technical Information Service, Springfield, VA 22161 as ORNL/TM-5948, Price codes: A03 in paper copy, A01 in microfiche. Report No ORNL/TM-5948, August 1977. ESD Pub No 1073, 28 p, 10 fig, 1 tab, 18 ref. W-7405-eng-26.

Descriptors: *Environmental effects, *Powerplants, Cooling water, *Entrainment, Models, Mortality.

In order to evaluate the effects of entrainment on aquatic organisms and to measure the mortality associated with each component of the cooling system, a power plant cooling system simulator has been designed and is presently under construction at the Oak Ridge National Laboratory. The apparatus has been designed so that the internal hydraulics of operating power plant cooling circuits will be effectively reproduced. Experiments are planned which will make use of fresh water and marine fish and zooplankton species. Rearing and holding facilities which will assure an adequate supply of specimens and also allow for assessment of delayed mortality have been constructed. The purpose of these investigations is the identification of factors contributing to mortality during entrainment to provide a basis for redesign of cooling system components with a resulting minimization of the environmental impacts of power plants. (Chilton-ORNL) W78-04050

EFFICIENCY OF NETS AND A NEW DEVICE FOR SAMPLING LIVING FISH LARVAE,
Lawler, Matusky, and Skelly, Tappan, NY.
P. M. McGroddy, and R. L. Wyman.

Journal of the Fisheries Research Board of Canada, Vol 34, 1977. p 571-574, 1 fig, 2 tab, 8 ref.

Descriptors: *Environmental effects, *Sampling, Larvae, *Mortality, *Nets, Efficiencies, Design, Fish larvae.

Mortality of fish larvae collected in plankton nets and in a new device which allows for control of water velocity during collection are compared. Test of the efficiency of the nets indicated a decline in the number of larvae captured with increase in water velocity. Recovery efficiency of the new device was 100% of the larvae entering it. Larval mortality was significantly reduced (27% control mortality = 13%) with the new sampling device. (Chilton-ORNL) W78-04056

THERMAL EFFECTS OF POWER PLANT ENTRAINMENT ON SURVIVAL OF LARVAL FISHES: A LABORATORY ASSESSMENT,
New York State Univ. at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5C. W78-04057

MORTALITY OF STRIPED BASS EGGS AND LARVAE IN NETS,
New York Univ. Medical Center, NY. Lab. for Environmental Studies.
For primary bibliographic entry see Field 5C. W78-04059

EFFECT OF SHEAR ON EGGS AND LARVAE OF STRIPED BASS, MORONE SAXATILIS, AND WHITE PERCH, M. AMERICANA,
Maryland Univ., Solomons. Chesapeake Biological Lab. and Estuarine Studies.
R. P. Morgan, II, R. E. Ulanowicz, V. J. Rasin, Jr., L. A. Noe, and C. B. Gray.

Transactions of the American Fisheries Society, Vol. 105, No. 1, January 1976, p 149-154, 1 fig, 3 tab, 13 ref.

Descriptors: *Environmental effects, Velocity, *Shear stress, Bass, *Striped bass, Eggs, *Larvae, Perch, *White perch, Mortality.

Variations in water velocity can produce shear fields which have a detrimental effect on fish eggs and larvae. Experimental results showed that 36% of striped bass eggs exposed to shear levels of 350 dynes/square cm were killed in 1 min; 69% in 2 min; and 88% in 4 min. 9.3% of larvae exposed to the same force were killed in 1 min; 30.0% in 2 min; and 68.1% in 4 min. At the shear level, 38% of white perch eggs were killed in 1 min; 41% in 2 min; 89% in 5 min; 96% in 10 min; and 98% in 20 min. 38% of white perch larvae were killed in 1 min; 52% in 2 min; and 75% in 4 min. These results are related to some characteristic shear values in the Chesapeake and Delaware Canal. (Chilton-ORNL) W78-04060

SHELL SIZE - FREQUENCY DISTRIBUTIONS OF CORBICULA MANILENSIS PHILIPPI FROM A CLAM-FOULED STEAM CONDENSER,
Texas Univ. at Arlington. Dept. of Biology.
R. F. McMahon.

The Nautilus, Vol. 91, No. 2, April 1977, p 54-59, 3 fig, 14 ref.

Descriptors: *Environmental effects, Powerplants, Condensers, *Clams, Fouling, Size, Design, Shellfish, Corbicula manilensis.

Whole specimens and whole and half shells of Corbicula manilensis were collected from the clam-fouled steam condenser of an electric generating plant. A comparison of the size distribution of the samples indicated that the clams fouling the condenser are not a resident population but must have been carried into it from an external population. The condenser tubes appeared to act as a sieve becoming fouled with shells of an appropriate size to become lodged in it. It was concluded that increasing the inside diameter of the tubes to 29.0 mm would allow all specimens to pass through and prevent fouling problems with these clams. (Chilton-ORNL) W78-04061

AQUATIC IMPACT ASSESSMENT AT CALVERT CLIFFS,
Martin Marietta Environmental Technology Center, Baltimore, MD.
For primary bibliographic entry see Field 5C. W78-04062

THE REACTION OF SMALL FISH TO PERFORATED PLATES,
California Univ., Berkeley. Dept. of Hydraulic Engineering.
J. A. Harder.

CONF-750980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975. Vol. 2. Technical and Topical Papers. p 118-127, 3 fig.

Descriptors: *Environmental effects, *Powerplants, Intakes, Screens, Fish, Fish behavior, Turbulence, *California Delta Peripheral Canal.

One of the proposals for excluding small fish from the intake structure to the California Delta Peripheral Canal has been to install a perforated plate screen along the banks of the Sacramento River through which the water would pass before being diverted to the canal. The present paper discusses problems involved with this proposal

SUBJECT SCIENTIFIC AND TECHNICAL INFORMATION—Field 10

Preparation Of Reviews—Group 10F

and the behavior of small fish. A device which is being constructed in the laboratory for study of the problem is described. It was considered that the investigation of hazards to small fish along a screened bank may lead to consideration of the effects of altered state of turbulence on fish behavior in general. (See also W78-04155) (Chilton-ORNL) W78-04163

EFFECTS OF ENTRAINMENT, ENTRAPMENT AND IMPINGEMENT,
Ecological Analysts, Inc., Baltimore, MD.
L. D. Jensen.
CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975, Vol 2. Technical and Topical Papers, p 136-141.

Descriptors: *Environmental effects, *Powerplants, *Entrainment, Monitoring, Sites, Reviews, Research programs, *Entrapment, *Impingement, Site specific studies.

The paper suggests areas of data collection effort that are relevant to both research and monitoring programs for entrainment and entrapment at steam electric generating stations. General comments are presented regarding that nature of sampling efforts and research problems in these areas. Site-specific features warrant detailed reviews of data requirements and sampling protocol before initiating extensive and costly studies suggested by various regulatory guideline documents. The complexity of these studies indicates that utility personnel should consult and develop specific sampling programs in concert with various regulatory scientists in order to prevent misunderstandings and conflicts that may be anticipated as a result of the development of these research and monitoring programs. A summary of research needs which includes pump and plume entrainment effects and entrapment, impingement effects is given. (See also W78-04155) (Chilton-ORNL) W78-04165

INVESTIGATIONS INTO MINIMIZING FISH LOSS AT STEAM ELECTRIC GENERATING STATIONS,
Southern California Edison Co., Rosemead.
J. A. Stipanov.

CONF-750 980, EPRI SR-38. In: Report of a Workshop on the Impact of Thermal Power Plant Cooling Systems on Aquatic Environments held in Asilomar, Pacific Grove, California, September 28-October 2, 1975, p 198-210, 6 fig.

Descriptors: *Environmental effects, *Engineering structures, Powerplants, Design, Fish, Mortality.

The paper reviews certain aspects of development work at Southern California Edison Company to mitigate fish loss at existing and future steam electric generating stations. Fish pump systems and inlet pipe configurations in use at some of the company's generating stations are described. It was concluded that a concrete velocity cap structure developed by the company in 1956 is the best system. A prototype installation of an improved velocity cap design was made in 1975 at a utility generating station. Evaluation of its performance will determine what course of action will be followed for new installations and what benefits modifications to existing caps might produce. (See also W78-04155) (Chilton-ORNL) W78-04171

PLANKTONIC FISH EGGS AND LARVAE OF THE LOWER CONNECTICUT RIVER AND THE EFFECTS OF THE CONNECTICUT YANKEE PLANT INCLUDING ENTRAINMENT,
NUS Corp., Pittsburgh, PA. Ecological Sciences Div.

For primary bibliographic entry see Field 5C.
W78-04181

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10B. Reference and Retrieval

PROGRAM OBJECTIVES FOR THE NATIONAL WATER DATA EXCHANGE (NAWDEX) FOR FISCAL YEAR 1978,
Geological Survey, Reston, VA. Water Resources Div.

For primary bibliographic entry see Field 7C.
W78-03767

10C. Secondary Publication And Distribution

IMPACT OF GROUNDWATER DEVELOPMENT IN ARID LANDS: A LITERATURE REVIEW AND ANNOTATED BIBLIOGRAPHY,
Arizona Univ., Tucson. Office of Arid Lands Studies.

For primary bibliographic entry see Field 4B.
W78-03757

BIBLIOGRAPHY OF REPORTS BY MEMBERS OF THE U.S. GEOLOGICAL SURVEY ON THE WATER RESOURCES OF ALASKA, 1870 THROUGH 1976,
Geological Survey, Anchorage, AK. Water Resources Div.
A. J. Feulner, and K. M. Reed.
Open-file report 77-687, 1977, 112 p.

Descriptors: *Bibliographies, Publications, *Water resources, Hydrology, *Alaska, Surface waters, Groundwater, Sediments, Water quality, Ice, Snow, Permafrost, Hydrogeology, Documentation.

This bibliography lists publications prepared by members of the U.S. Geological Survey and published either by the Survey or by the other agencies and organizations between 1870 and the end of December 1976. The titles included are those whose primary topic is hydrology, water resources, or other aspects of water in Alaska. Related subjects, such as geology, included in many of these reports. (Woodard-USGS) W78-03778

TEMPERATURE REQUIREMENTS OF SOME PERCIDS AND ADAPTATIONS TO THE SEASONAL TEMPERATURE CYCLE,
Environmental Research Lab.-Duluth, Monticello, MN. Monticello Ecological Research Station.
For primary bibliographic entry see Field 02H.
W78-04124

CHEMISTRY AND EFFECTS OF CHLORINE IN AQUATIC SYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 05C.
W78-04127

10F. Preparation Of Reviews

SNOW MECHANICS SYMPOSIUM.
International Association of Scientific Hydrology, Gentbrugge (Belgium).
For primary bibliographic entry see Field 02C.
W78-03998

COLLECTIVE AND LOCAL INDIVIDUALISM

By ROBERT D. KELLY

THE AUTHOR is a professor of political science at the University of Wyoming. He is the author of *Political Parties in the United States* (1969).

THEORY AND PRACTICE IN
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ANTARCTIC OASIS	(Influence de la Pollution par les eaux D'égouts sur la Composition en Azote Total, en Proteins et en Acides Amines de la Phanerogame Marine <i>Cymodocea Nodosa</i>), W78-04141	5C	Urban Flood Water Management Systems in Semiarid Regions: Model Extension, Design and Application, W78-03965	6A																																																																																																																																																																	
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| ANTARCTICA | Flora and Fauna in Freshwater Bodies of the Thala Hills Oasis (Enderby Land, Eastern Antarctica),
W78-03830 | 5C | Landsat Linear Trend Analysis: A Tool for Groundwater Exploration in Northern Arkansas,
W78-03752 | 4B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ANTIBIOTICS (PESTICIDES) | Flora and Fauna in Freshwater Bodies of the Thala Hills Oasis (Enderby Land, Eastern Antarctica),
W78-03830 | 5C | ARMY ENGINEER DISTRICT-SACRAMENTO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Effects of Antimycin A and Rotenone on Macrobenthos in Ponds,
W78-03724 | 5C | Plan Formulation and Evaluation Studies-Recreation. Volume V, A Generalized Recreation Day Use Planning Model,
W78-03895 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ANTIMYCIN A | Aquatic Macroinvertebrates in a Small Wisconsin Trout Stream Before, During, and Two Years After Treatment with the Fish Toxicant Antimycin,
W78-03725 | 5C | ARSENIC COMPOUNDS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Effects of Antimycin A and Rotenone on Macrobenthos in Ponds,
W78-03724 | 5C | Arsenic Content and Its Seasonal Variation in Seaweed, (In Japanese),
W78-03712 | 5A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Aquatic Macroinvertebrates in a Small Wisconsin Trout Stream Before, During, and Two Years After Treatment with the Fish Toxicant Antimycin,
W78-03725 | 5C | Heavy Metals, Selenium and Arsenic in Nine Species of Australian Commercial Fish,
W78-03713 | 5A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| AQUATIC ALGAE | Aquatic Macroinvertebrates in a Small Wisconsin Trout Stream Before, During, and Two Years After Treatment with the Fish Toxicant Antimycin,
W78-03725 | 5C | ARTIFICIAL LAKES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Copper Sorption and Release by <i>Cyclotella meneghiniana</i> (Bacillariophyceae) and <i>Chlamydomonas reinhardtii</i> (Chlorophyceae),
W78-03945 | 5C | Lakes and Ponds,
W78-03842 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| AQUATIC BACTERIA | AQUICULTURE | | ARTIFICIAL RECHARGE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Relationships Between Potassium Permanganate Treatment and Water Quality,
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W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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 | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | |
 | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A |
 | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | | | | | | | | | | | | | | |
| AQUATIC FUNGI | Asbestos Content and Its Seasonal Variation in Seaweed, (In Japanese),
W78-03712 | 5B | Identification of Asbestos-Materials in Suspended Solids,
W78-03934 | 5A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Acute and Chronic Toxicity of Chlordane to Fish and Invertebrates,
W78-03921 | 5C | Asbestos Fibers in Natural Runoff and Discharges from Sources Manufacturing Asbestos Products. PT II-Non-Point Sources & Point Sources Manufacturing Asbestos Products,
W78-04150 | 5B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Transport of Granitic Sediment in Streams and Its Effects on Insects and Fish,
W78-03928 | 2J | ASCORBIC ACID | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Feeding Ecology of the Bluegill, <i>Lepomis Macrochirus</i> , in Two Heated Reservoirs of Texas, III. Time of Day and Patterns of Feeding,
W78-04139 | 2H | Effect of Dietary Ascorbic Acid on the Accumulation of Copper in Carp,
W78-03948 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| AQUATIC MICROORGANISMS | AQUIFERS | | ASIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Degradation of Malathion by Salt-Marsh Microorganisms,
W78-03818 | 5B | Defining Reactions and Mass Transfer in Part of the Floridan Aquifer,
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W78-04113 | 5C | 5C | AUSTRIA | | ATLANTIC SALMON | | 5C | The Use of Ion Exchange Methods for Determining Trace Elements in Natural Waters: VII. Copper, (In German),
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W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| The Effects of Pollution by Sewage on the Total Nitrogen, Protein and Amino Acids of the Marine Phanerogam <i>Cymodocea Nodosa</i> | Impact of Groundwater Development in Arid Lands: A Literature Review and Annotated Bibliography,
W78-03757 | 4B | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5C | Water-Resources Investigations in Arizona, 1977,
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W78-03744 | 5C | 5C | ASSESSMENTS | | ATLANTIC SALMON | | 5C | Assessment of Effects of Altered Stream Flow Characteristics on Fish and Wildlife. Task 3: Analysis of Case Study Findings, Identification of Problems, and Recommendation of Remedies,
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W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | |
Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5C | Assessment of Effects of Altered Stream Flow Characteristics on Fish and Wildlife. Task 3: Analysis of Case Study Findings, Identification of Problems, and Recommendation of Remedies,
W78-03722 | 5C | 5C | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5C | AUSTRIA | | ATLANTIC SALMON | | 5C | The Use of Ion Exchange Methods for Determining Trace Elements in Natural Waters: VII. Copper, (In German),
W78-03939 | 5A | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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| 5C | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
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| 5C | AUSTRIA | | ATLANTIC SALMON | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5C | The Use of Ion Exchange Methods for Determining Trace Elements in Natural Waters: VII. Copper, (In German),
W78-03939 | 5A | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
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W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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 | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile
Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ASIA | | 5A | | | A Study of Maximum Flood Discharge Formulas,
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W78-03744 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | 5A | | | ASSESSMENTS | | 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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W78-03813 | 4A | 5A | | | ASPHALT | | 5A | | | Chemical Stabilization of Soft Soils,
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W78-03897 | 6B | 5A | | | ATLANTIC SALMON | | 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
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| 5A | | | ATLANTIC SALMON | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ATLANTIC SALMON | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ATLANTIC SALMON | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ATLANTIC SALMON | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Seawater Adaptation and Parr-Smolt Transformation of Juvenile Atlantic Salmon, <i>Salmo Salar</i> ,
W78-04113 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASSESSMENTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Rocky Mountain Environmental Research Quest for a Future. Problems and Research Priorities in the Rocky Mountain Region.
W78-03897 | 6B | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASIA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | A Study of Maximum Flood Discharge Formulas,
W78-03813 | 4A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | ASPHALT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| 5A | | | Chemical Stabilization of Soft Soils,
W78-03744 | 5C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Design of Water Resources Projects with Inadequate Data, Volume 2, W78-03783	4A	Determination of Evaporation in Case of the Absence or Inadequacy of Data, W78-03794	2D	Water Conservation: Dramatic Changes Taking Place, W78-03851	3E	INCOME LOSS				Water Shortage in Israel: Long-Run Policy for the Farm Sector, W78-03990	3F	Commercial and Institutional Water Use in Puerto Rico, W78-04097	6B	INCUBATION				Effects of Prolonged Exposure to Ammonia on Fertilized Eggs and Sac Fry of Rainbow Trout (Salmo Gairdneri), W78-03708	5C	INDUSTRIES				Relation Between Temperature and Incubation Time for Eggs of Chinook Salmon (Oncorhynchus Tshawytscha), W78-04114	5C	INFORMATION EXCHANGE				Designing Projects for the Development of Ground Water Resources in the Alluvial Plains of Northern India on the Basis of Inadequate Data, W78-03799	4B	INFORMATION SYSTEMS				INDIAN RESERVATIONS				Seepage Tests on No Name Creek, Colville Indian Reservation, Washington, May 12-13, 1977, W78-03777	4B	INHIBITORS				INDIRECT FLOOD MEASUREMENT				Flood Plain Information: Conemaugh and Little Conemaugh Rivers, Stony and Bens Creeks, City of Johnstown and Vicinity, Cambria and Somerset Counties, Pennsylvania. W78-03906	4A	INLAND WATERWAYS				Flood Plain Information: Peters Creek, Jefferson Borough, Allegheny County, Pennsylvania. 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Flood Plain Information: Conemaugh and Little Conemaugh Rivers, Stony and Bens Creeks, City of Johnstown and Vicinity, Cambria and Somerset Counties, Pennsylvania. W78-03906	4A	INLAND WATERWAYS				Flood Plain Information: Peters Creek, Jefferson Borough, Allegheny County, Pennsylvania. W78-03907	4A	INORGANIC COMPOUNDS				INSTRUMENTATION				INVESTIGATIONS				INTER-AGENCY COOPERATION				INTER-REGIONAL I/O MODEL				INPUT-OUTPUT ANALYSIS				INSECTICIDES				INSTREAM FLOW				INSTRUMENTATION				INTAKE				INTENSITY				INTER-AGENCY COOPERATION				INTER-REGIONAL I/O MODEL				INPUT-OUTPUT ANALYSIS				INSECTICIDES				INSTREAM FLOW				INSTRUMENTATION				INTAKE				INTENSITY				INTER-AGENCY COOPERATION				INTER-REGIONAL I/O MODEL				INPUT-OUTPUT ANALYSIS				INSECTICIDES				INSTREAM FLOW				INSTRUMENTATION				INTAKE				INTENSITY				INTER-AGENCY COOPERATION				INTER-REGIONAL I/O MODEL				INPUT-OUTPUT ANALYSIS				INSECTICIDES				INSTREAM FLOW				INSTRUMENTATION				INTAKE				INTENSITY				INTER-AGENCY COOPERATION				INTER-REGIONAL I/O MODEL				INPUT-OUTPUT ANALYSIS				INSECTICIDES				INSTREAM FLOW				INSTRUMENTATION				INTAKE				INTENSITY				INTER-AGENCY COOPERATION				INTER-REGIONAL I/O MODEL				INPUT-OUTPUT ANALYSIS				INSECTICIDES				INSTREAM 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